

AMERICAN JOURNAL OF OPHTHALMOLOGY

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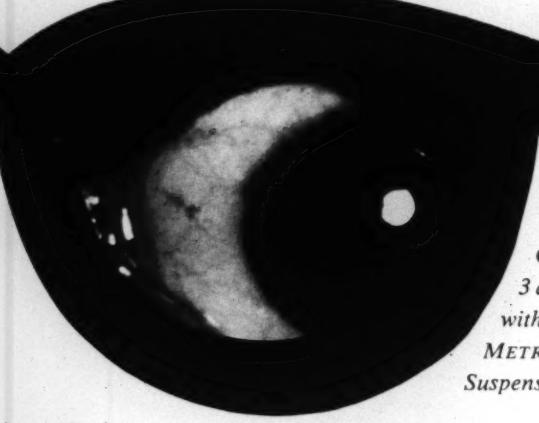
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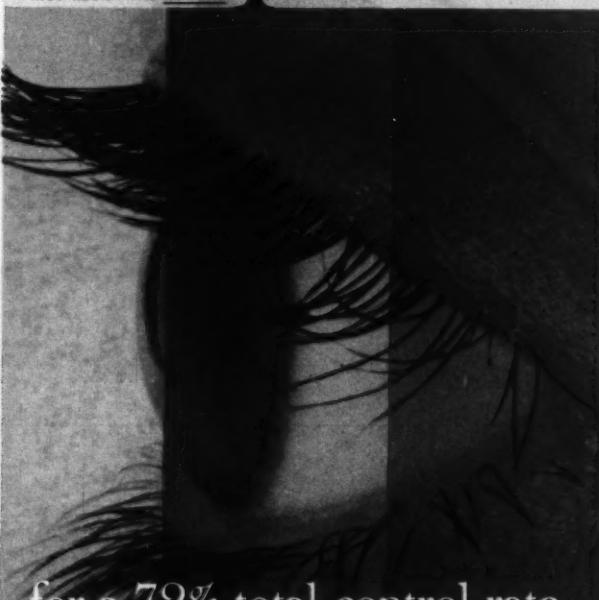
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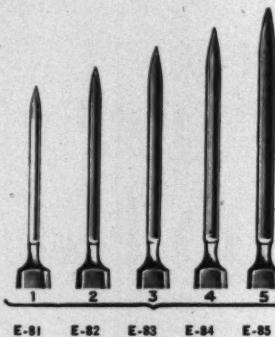




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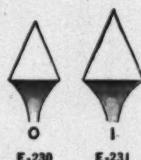
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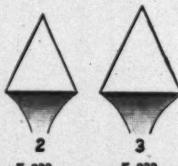
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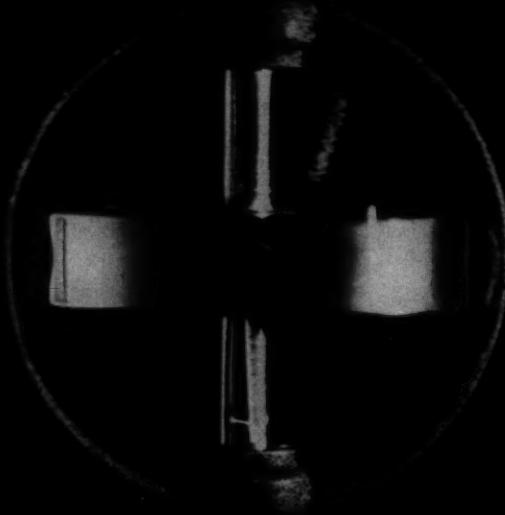


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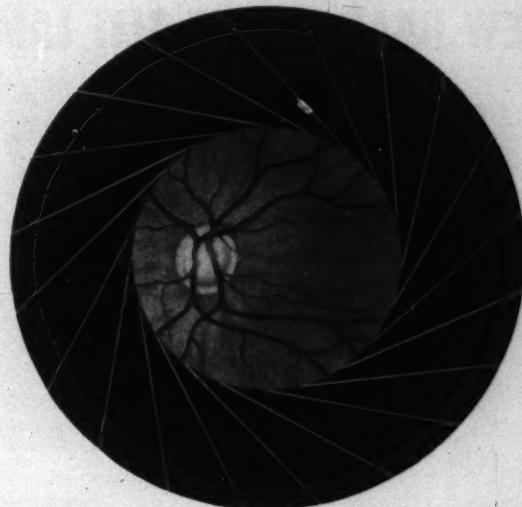
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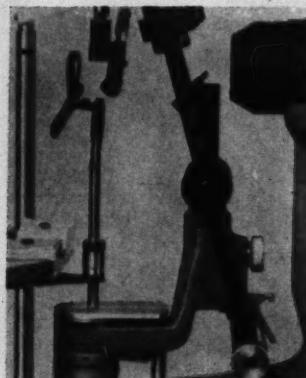
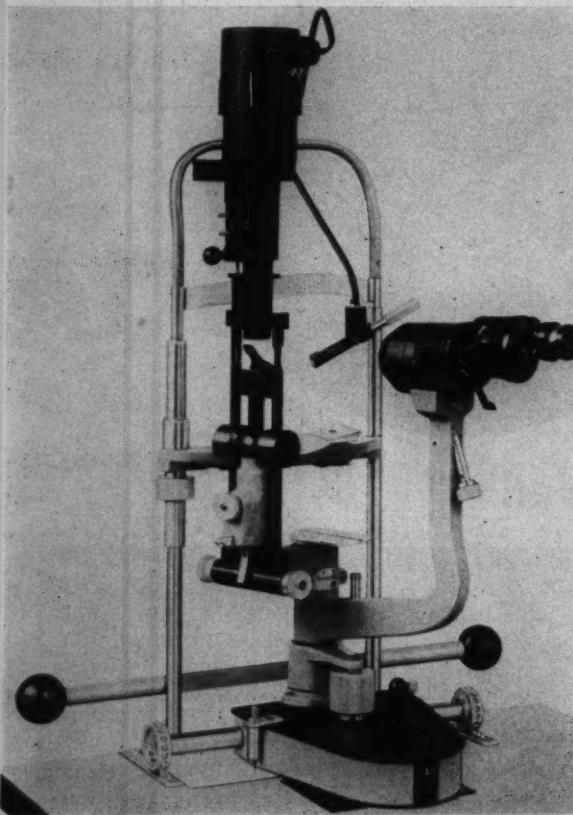
Perry, B. S.; Medina, M. M., and Phillips, C. C. To be published. 2. Abiquist, R. P. In Dell, V. A. *Principles and Practice in Medicine*, McGraw-Hill Book Company, Inc., New York, 1954, p. 1820.

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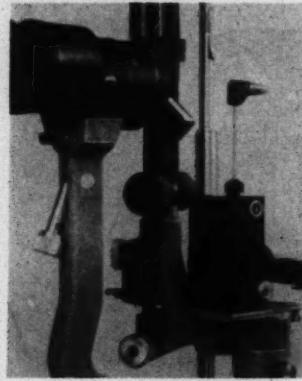
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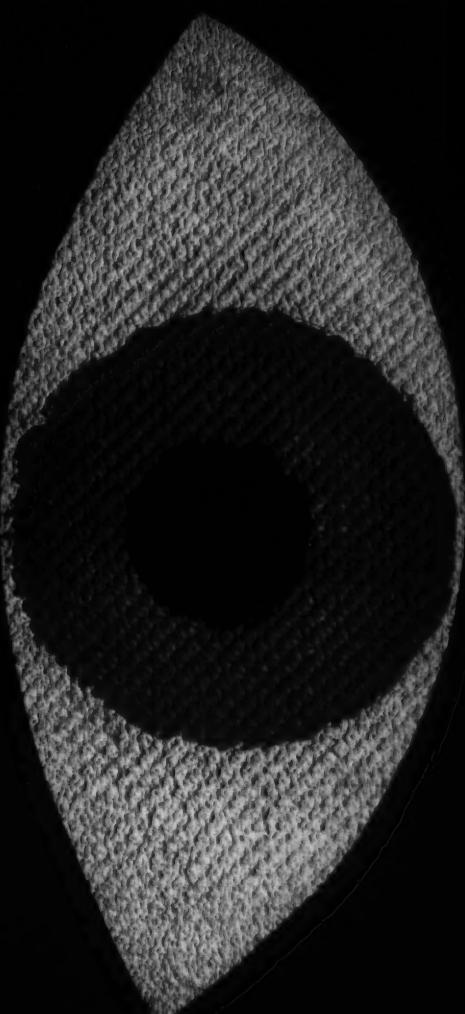
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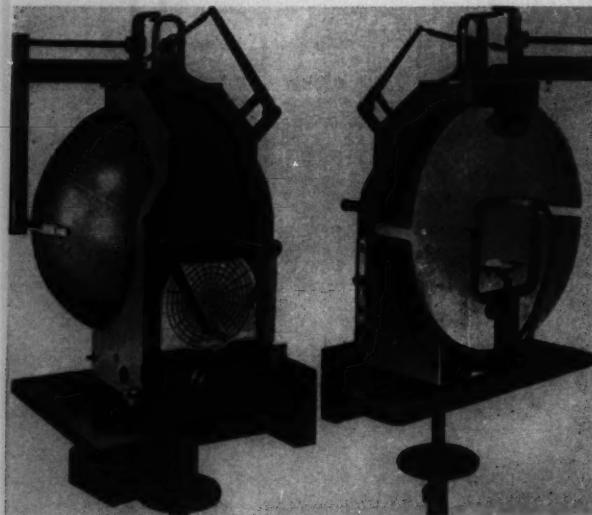
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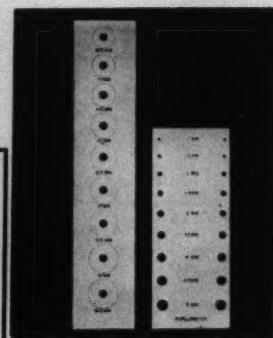
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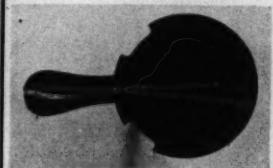
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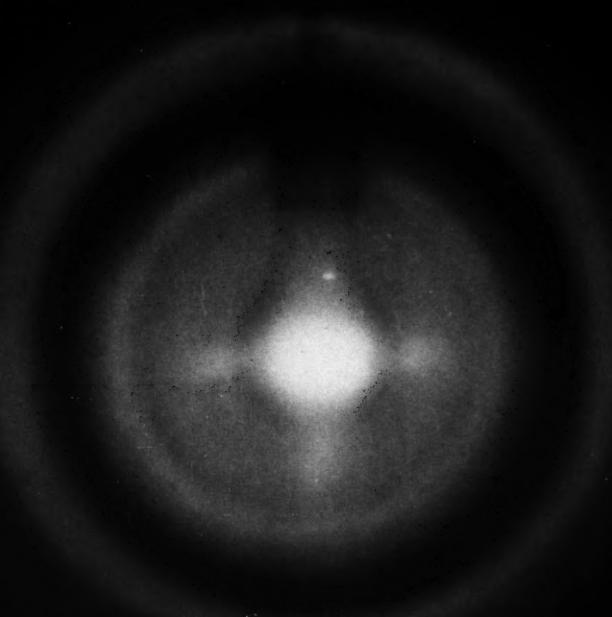
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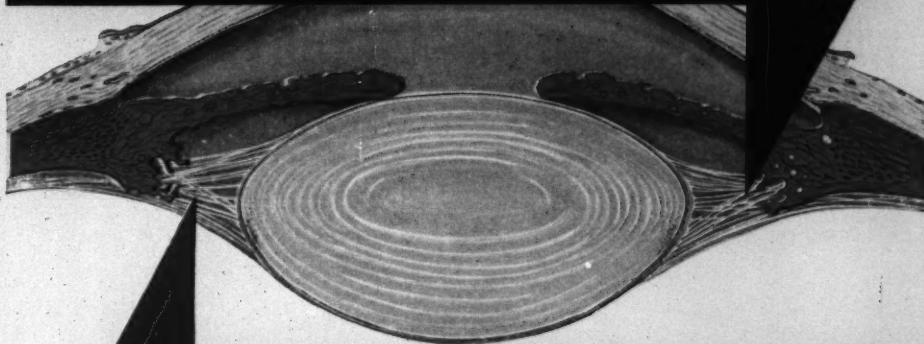
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1. Raiford, M. D.: J. M. A. Georgia 48:163, 1959. 2. Rizzuti, A. B.: A. M. A. Arch. Ophth. 61:135, 1959. 3. Cogan, J.E.H.: Proc. Roy. Soc. Med. 51:927, 1958.



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von Noorden, G. K. and Burian, H. M. "Visual Acuity in Normal and Amblyopic Patients under Reduced Illumination." *Archives of Ophthalmology*, Vol. 61, (April, 1959), pp. 533-535.

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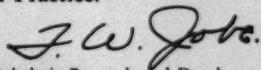
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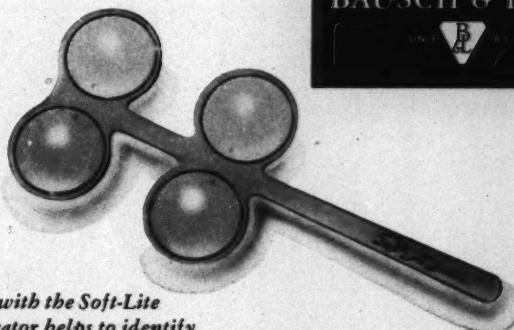
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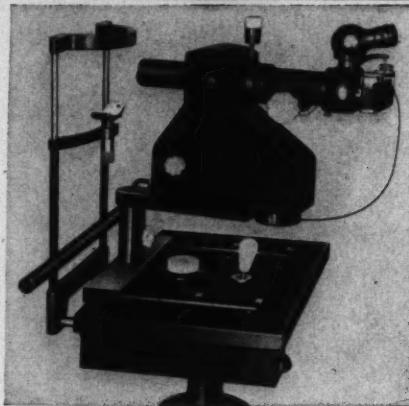
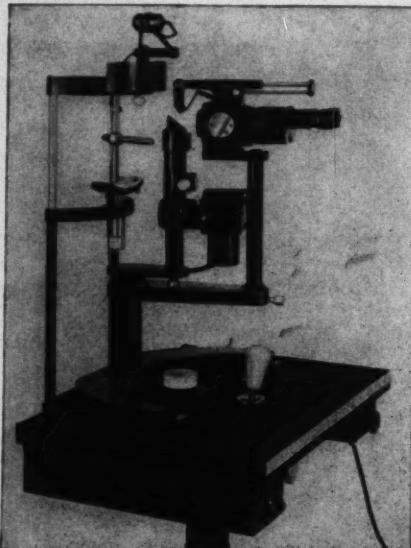
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1. Am. J. Ophth. 42:771, 1956.
2. Am. J. Digest Dis. 22:5, 1955.
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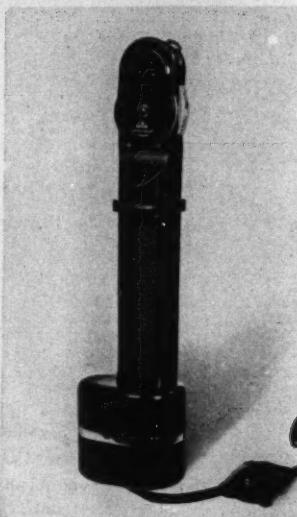


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SERIES 3 · VOLUME 48 · NUMBER 1, PART I · JULY, 1959

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ABSTRACTS

Vegetative physiology, biochemistry, pharmacology, toxicology; Physiologic optics, refraction, color vision; Diagnosis and therapy; Ocular motility; Conjunctiva, cornea, sclera; Uvea, sympathetic disease, aqueous; Glaucoma and ocular tension; Crystalline lens; Retina and vitreous; Optic nerve and chiasm; Neuro-ophthalmology; Eyeball, orbit, sinuses; Eyelids, lacrimal apparatus; Tumors; Injuries; Systemic disease and parasites; Congenital deformities, heredity; Hygiene, sociology, education, and history	120
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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 48

JULY, 1959

NUMBER 1, PART I

REPORT ON A COMBINATION OPERATION FOR CATARACT WITH GLAUCOMA

WENDELL L. HUGHES, M.D.

Hempstead, New York

Not infrequently in the long-term management of cases of glaucoma and occasionally in the long-term management of a case of cataract, complications ensue wherein there arises the question of the choice of surgery for the removal of the lens, considering the possibility or likelihood that there might be an increased tension following the removal of the lens. The decision as to the type of surgery to be done is always a serious one. Some surgeons prefer to do the glaucoma surgery first and then remove the cataract; others prefer to remove the cataract and then take care of the glaucoma subsequently, if necessary. A few have advocated a combination operation for the two conditions at the same time.

There are very few references in the literature to simultaneous operations for glaucoma and cataract. In 1952, Birge¹ read a paper before the American Ophthalmological Society presenting a combined procedure of cataract extraction with iridencleisis for cases of cataract combined with glaucoma. Subsequently to the publication of this article Dr. Birge has done some cases using an anterior sclerectomy as well. Wenaas and Stertzbach² have also reported favorably on a combination operation (similar to the one reported by Birge) in 25 cases. Lee and Weih,³ in discussing cataract and glaucoma, advise a fistulizing operation to be done at the same time as the extraction of the cataract and report on 25 cases in which some fistulizing operation was done at the time of extraction, in 20 of which no further miotics were necessary. Wolfe⁴ described a series of cases of cataract

extraction with a filtering operation.

There are cases of glaucoma that have been under control with medication for a long time in which vision declines due to ensuing lens changes. The miosis induced by the glaucoma medication frequently increases the visual defect, often out of all proportion to the lens changes and the patient frequently neglects or refuses to use the drops on this account. In these cases surgery is naturally postponed as long as useful vision is maintained until finally one is forced to a decision to remove the cataract. If a routine extraction is planned one hopes that the glaucoma will still be under control postoperatively, as it was preoperatively. Sometimes this hope is, of course, realized but if the glaucoma flares up it is frequently quite severe and impossible to control medically and often resistant to surgery, with frequent serious loss of vision and not infrequently loss of the eye.

There are those cases of glaucoma that for years have had satisfactory control of tension following surgery of some sort with or without medication, where the increasing lens changes force one to decide on the removal of the lens because of incapacitating loss of vision. In these cases whether a routine extraction or an extraction with corneal incision in front of a filtering wound, or incision through or behind a filtering wound, or elsewhere around the limbus, there is always the danger that something will interfere with the glaucoma control postoperatively and one will be faced with the most serious type of glaucoma which occasionally follows the cataract operation. I think we

have all had the experience of having removed a cataract, after a successful operation for glaucoma, only to find a reactivation of the glaucomatous process postoperatively.

There are also those cases of cataract that have been followed for years that more or less suddenly develop an increase of tension with or without much in the way of symptoms. In these cases a routine operation for the removal of the cataract is often done fairly early in the glaucomatous process especially if the anterior chamber is shallow, in the hope that the removal of the cataract will automatically relieve the increased tension. Sometimes it does, but at other times the anterior chamber angle has been obstructed so long that the glaucoma continues after the lens is removed. It is next to impossible to determine beforehand in which cases the tension will be relieved and in which ones it will continue to be a problem.

In all of the above and many other cases in which there is any question of an increased intraocular pressure following the operation, I feel that some procedure should be done at the time of the extraction that will eliminate, or at least lessen, the tendency to increase of intraocular pressure subsequently. It is particularly indicated in cases in which there is also the additional complication of a uveitis.

The operation about to be described has been done in over 60* cases of cataract with various types of glaucoma with subsequent control of tension without miotics in all but four cases. In some the glaucoma preoperatively was quite severe, in others it had been under control preoperatively. The first case, done in 1931, consisted of removal of the cataract in combination with an anterior sclerectomy and iris inclusion in a case of chronic glaucoma with previous uveitis. There was preservation of good vision (20/15 with each eye) for 20 years until her death at the age of 83 years. It has been done for the removal of cataract in various

stages and in glaucoma of all types even including three cases with uveitis as well.

The visual results have been comparable to an ordinary cataract extraction except of course for the permanent visual loss occasioned prior to the operation by the glaucomatous process.

The procedure presupposes the skill in the surgeon necessary to perform a cataract extraction and anterior sclerectomy with iris inclusion. The complications are those one would expect with a filtering glaucoma operation and with a cataract extraction. Of course when it is necessary to operate in the face of an elevated tension the operation itself is naturally somewhat more difficult and the complications more numerous than in an uncomplicated cataract extraction.

It is preferable to remove the lens intracapsularly but sometimes this is impossible. When the capsule is ruptured, the soft lens matter should be removed as thoroughly as possible, as well as fragments of the capsule. If there is vitreous loss the wound should be cleaned of vitreous remnants and for this purpose the erisophake may be used as a "vacuum cleaner." When either of these two eventualities happen it is particularly valuable to have a good sclerectomy as well as having the iris pillar in the wound.

TECHNIQUE OF COMBINATION OPERATION FOR CATARACT EXTRACTION WITH ANTERIOR SCLERECTOMY AND IRIS INCLUSION

Under local instillation of pontocaine and subfascial and subconjunctival injections of procaine hydrochloride (two or four percent), an arcuate conjunctival incision is made eight to 10 mm. above and concentric to the limbus. The conjunctiva is deeply undermined down to the limbus over the upper one third of its circumference. This flap is held down over the cornea and, at a portion of the limbus which will later be at the location of one of the iris pillars, the periphery of the cornea is split at a level of about one half its thickness for a distance of two mm. into the cornea over a length of about seven mm.

* Nearly 100 cases as of May 3, 1959. Some of the early records have been lost.

along the limbus. This dissection is similar to the corneal splitting of an Elliot trephining operation (fig. 1).

A Wheeler discussion knife or very thin cataract knife is then entered at the limbus under the conjunctival flap, passed across the anterior chamber with the flap held up out of the way so the knife tip may be watched as it traverses the usually narrow anterior chamber angle. The point of the knife enters the anterior chamber angle about 12 mm. distant and emerges in the sclera under the conjunctival flap nasally (fig. 2) just beyond the location of the pillar which will later be drawn out into the wound. As (cross-section fig. 2) the cut is made, it slopes farther back into the scleral tissues near the center and is stopped just before completion leaving a small bridge of sclera which is left intact until the incision is enlarged nasally and temporally and the sutures are placed.

The limbus wound is lengthened nasally and temporally with scissors to nearly 180 degrees and sutures are placed. Two mattress sutures are placed, one at each end of the location planned for sclerectomy, using 6-0 chromic gut sutures. The new sutures* swaged on very sharp needles are ideal for this operation. One needle is passed parallel to the limbus through the superficial half of the cornea at one end of the planned sclerectomy for a distance of 1.5 to 2.0 mm. of cor-

neal tissue (right-hand suture fig. 3). Each needle is then passed through the base of the conjunctival flap and the corneal margin at the limbus. They then enter the sclera superficially directly opposite and traverse the superficial part of the sclera and the episcleral tissue for five to seven mm. above the incision where the first double turn of a surgeon's knot is laid ready for pulling up later (left-hand suture fig. 3), immediately behind the emerging lens.

A second double-arm suture parallels the first at the other end of the planned sclerectomy and the first turn of the knot similarly placed. Loops of suture large enough to allow the lens to be removed are left. The scleral wound incision above is completed with scissors and the tip of scleral lip is grasped with a forceps (fig. 4). This lip of sclera and limbus tissue between the corneal splitting incision and the deeper Wheeler knife incision is excised (crosslined area in figs. 1 and 2) with an iris scissors or punch, cutting well in on the inner lip of the corneal portion to include the periphery of Descemet's membrane (fig. 5 cross section). The iris is grasped to one side of the planned sclerectomy and a radial cut made from the pupillary margin to its root. The iris is torn off at its root to the midpoint of the sclerectomy and laid out through the wound.

The lens is then extracted in its capsule. The sutures are then pulled up closing the

* Ethicon 790.

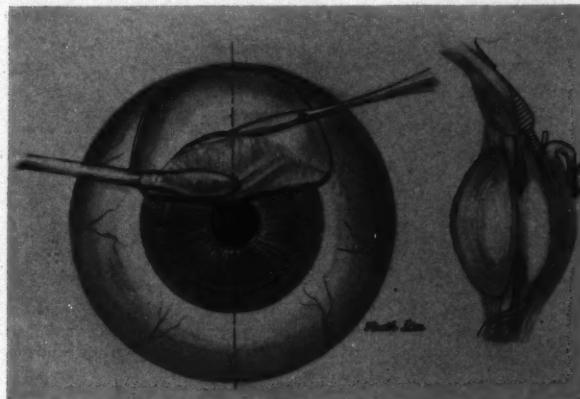


Fig. 1 (Hughes). Dissection of conjunctival flap and corneal splitting. Cross section shows knife splitting cornea and cross-lined piece that will be excised.

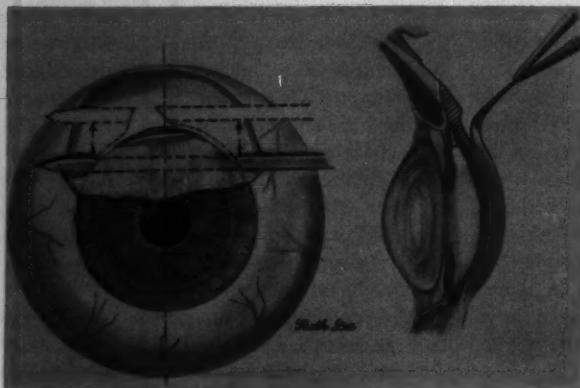


Fig. 2 (Hughes). Wheeler discission knife across the anterior chamber in full outline at the start of the deeper limbus incision and, in broken outline, ready to be withdrawn, leaving a small bridge of sclera intact. Cross section shows knife in anterior chamber angle and crosslined section of sclera to be removed with scissors later.

wound snugly immediately behind the emerging lens and the knots completed and tied. The base of the iris is straightened out and left as a wick through the sclerectomy opening (fig. 5) being careful not to pull too much iris out. If too much tension is placed on the iris, it may result in a drawn-up pupil later. The conjunctival flap is then accurately closed with a running suture of 6-0 gut. Penicillin (50,000 units) and 50,000 units of Aerosporin are successively injected subconjunctivally above in separate areas. The other iris pillar is replaced. Both eyes are covered as in a routine cataract extraction for the first three days.

The postoperative course is about the same as for an uncomplicated cataract extraction except that the anterior chamber is usually flat for four to 14 days but reforms in about all cases with either an extreme mydriatic (neosynephrine 10 percent) and/or extreme miotic (floropryl). Rarely air may need to be injected into the anterior chamber or a leaky wound repaired. Patients are ready for glasses in about the same time as after an ordinary cataract operation.

A stained section of the piece of the corneal periphery and sclera is shown in Figure 7. In this section, the periphery of Descemet's membrane and Schlemm's canal may be identified. In some cases Schlemm's canal cannot be identified.

DISCUSSION

In general the results have been particularly satisfactory. The first case was done in 1931 and was followed for almost 18 years with normal tension without the use of miotics and vision of 20/15 with each eye at all times. I have been able to collect the records of over 55 operations of this type. It will be seen that in all but four of these eyes there was complete relief of the increased tension without the further use of miotics. Vision was restored except, of course, in the cases in which the glaucoma or other pathologic con-

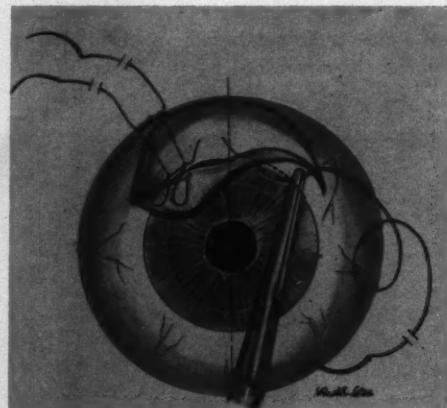


Fig. 3 (Hughes). Chromic gut 6-0 mattress sutures being placed prior to the sclerectomy and lens extraction so they may be drawn up immediately behind the emerging lens.



Fig. 4 (Hughes). Tip of sclera picked up and stretched so the scissors may cut the sclerectomy well inside to include the margin of Descemet's membrane and Schlemm's canal.

ditions produced irreparable visual damage.

It is readily recognized that in some of the cases reported the glaucoma might have been relieved by the cataract operation alone but in many of the cases here reported, especially

those of long standing glaucoma, the glaucoma would certainly have continued post-operatively had not some fistulizing procedure been done. While a series of 55 eyes is a small one, I believe the results justify this report in the hope that others may be stimulated to do this operation and further evaluate the results. The indications for this type of operation are certainly not rare.

CASE REPORTS

CASE 1

Mrs. T. B., aged 63 years, was first seen in 1929 with chronic simple glaucoma. Under control with miotics and vision 20/30 with each eye. Bjerrum scotoma in each eye. Peripheral fields for three-mm. object showed slight upper nasal cut with moderate general contracture for each eye. Under miotics tension was under fair control rising to 40 mm. Hg at times toward the end of a two-year treatment period. By 1931, she had also developed nuclear sclerosis with cortical opacities and vision was reduced to right eye, 20/100, and left eye, 20/70, with inability to read. In May, 1931, an intracapsular cataract extraction with anterior sclerectomy and iris inclusion (the combination operation) was done on the right eye, and six months later on the left eye. This woman was followed intermittently until her death in 1949 and the corrected vision was always 20/15 with each eye. Tension and fields taken at repeated visits were found constantly to be normal.

CASE 2

Mrs. B. K., aged 77 years, was seen at home with history of blurred vision left eye for two or three years. Now only has good light projec-

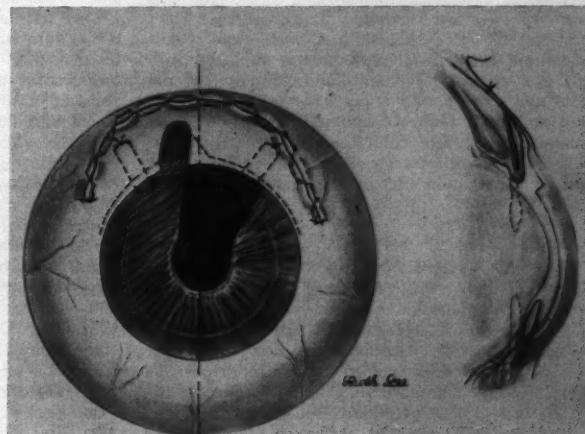


Fig. 5 (Hughes). Final closure—two mattress sutures tied subconjunctivally—tip of iris pillar drawn out through sclerectomy opening. Conjunctiva and fascia closed accurately. Cross section shows iris tip pulled out into the wound and sclerectomy.

tion. Sees some spots but can read with a magnifying lens. Tension felt slightly elevated to fingers in left eye. Three weeks later the patient was again seen at home with history of painful left eye for one week. The cornea was steamy, pupil mid-dilated and fixed. Tension was markedly elevated. She was sent immediately to the hospital and the combination operation was done on February 23, 1952. She was discharged in seven days and healing was uneventful. Subsequently no miotics were used and tension remained normal for at least eight months when last seen shortly before her death from a heart ailment. Vision was 20/25 with correcting lenses. Fields showed slight constriction up to fixation and temporally, being the same pre- and postoperatively.

CASE 3

Mrs. B. F., aged 68 years, was first seen September 17, 1946, with gradual loss of vision in the left eye for several years. Vision was: R.E., 20/20; L.E., 20/70. Tension was: R.E., 40 mm. Hg; L.E., 48 mm. Hg. Shallow anterior chambers. Fields: nasal constriction of left field to within eight degrees of fixation with temporal constriction to about 40 degrees left eye, with full field right eye. Anterior sclerectomy with iris inclusion done on right and left eyes a week apart in November, 1946. By the following May vision was: R.E., counting fingers at six feet; L.E., poor light projection. The tension had been normal under pilocarpine. Combination operation was done May 23, 1947, on the right eye with resulting vision of 20/30 and normal tension for eight years without miotics. There was a good filtration bleb above. The left eye had become phthisical with poor projection.

CASE 4

Mrs. M. C., aged 72 years, had a history of glaucoma for 14 years. Bilateral iris inclusion had been done. Vision had deteriorated in the past two years to right eye, counting fingers at two feet; left eye, 5/200. Fields showed, right eye, slight peripheral constriction with central scotoma, and, left eye, normal peripheral limits. Fundus of the right eye could not be seen; left, very full red reflex, no details visible. Combination operation done January, 1948, left eye. Four years later vision was 20/30 with tension normal without drops since the operation. Peripheral fields were normal (10/330).

CASE 5

Mrs. F. W., aged 61 years, was first seen October 21, 1949, with a history of having been treated for glaucoma for the past eight years. Vision was: R.E., 20/20; L.E., 20/30, with correction. Anterior chambers shallow. Tension: R.E., 30; L.E., 41 mm. Hg (new Schiøtz). Fields were slightly contracted and blindspots slightly enlarged. Pilocarpine prescribed but tension remained the same. On October 20, 1949, a trephination was

done on the left eye and four days later on the right eye. The tension was controlled in the left eye but not in the right eye, ranging in the latter from 35 to 55 mm. Hg for the next two months and the vision dropped to counting fingers at one meter. On January 6, 1950, the combination operation was done on the right eye with rupture of the left capsule while delivering the lens. The tension remained normal but there was considerable soft lens matter present which became encapsulated. An anterior capsulotomy was done through a keratome incision in the cornea temporally and the soft lens matter washed out. There was a slight hemorrhage into the anterior chamber when an anterior iris synechia was cut. One month later the vision of the right eye was 20/15 with correcting lenses and has remained so ever since. The tension has remained normal without miotics. The vision of the left eye remained at 20/70 and the tension a high normal under miotics for two years following the trephination. There was considerable nuclear sclerosis, sufficient to account for the loss of vision. On May 21, 1951, the combination operation was done on the left eye with resulting vision of 20/20 and tension normalized without miotics up to the present (seven years).

CASE 6

Mr. W. B., aged 66 years, was first seen September, 1950, with the complaint of the blurring of vision two years prior. About one year ago the right eye began to blur then both had become worse. The patient used miotics prescribed by another physician for approximately six weeks and then discarded them. The patient was in general good health with a history of a coronary attack approximately six years before. Uncorrected vision 20/200 in each eye; with best correction 20/30+ right; and 20/30- left; reads 0.87 mm. characters at 300 mm. with a +3.0D add. External examination was entirely negative. Finger tensions indicated a two-plus rise in intraocular pressure. Tension with a tonometer was 55 mm. Hg in each eye. Patient was placed on two-percent pilocarpine three times daily and in October it was noted that the pressure had dropped to 22 mm. Hg in each eye. In November, 1950, corrected vision in both eyes was 20/30+.

In January, 1951, the patient again complained of decreasing vision. Best corrected vision was 20/30 with the right and 20/25 with the left.

The visual fields at the first visit showed a marked constriction (3/330) for the left eye and a full field for the right. The field outlines were irregular but remained constricted on the left and full on the right in January, 1951, November, 1951, and December, 1951. In April, 1951, the vision measured 20/40 in each eye with best correction and reading ability had decreased somewhat but the intraocular pressure on pilocarpine (two percent, three times daily) remained in the 20's. In June, 1951, the patient complained of

further decreased vision. It measured 20/100, R.E.; 20/60, L.E., with correction. At this time it was felt that a beginning cataract had obstructed his vision of the left eye and the cataract in the right eye which was first noted in January, 1951, had progressed to a point where his vision was considerably reduced.

On June 11, 1951, a cataract extraction with anterior sclerectomy and iris inclusion was done on the right eye with uneventful recovery with the exception of a flat anterior chamber nine days postoperatively. This responded only moderately to miotics and/or cycloplegics, and it was noted that the patient had neglected to use the drops prescribed on his discharge. On June 23, 1951, 0.5 cc. of air was injected into the anterior chamber and the vitreous was separated from the cornea. On June 25th it was noted that a corneal bleb had begun to form but by the 30th the eye had returned to a normal postoperative course with very little reaction. Finger tension had remained constantly in the low normal range. In August, 1951, the vision of the right eye was recorded as 20/25 with a correction. In November, 1951, vision was recorded as right 20/40+ and left 20/30-. The intraocular pressure was R.E., 25 mm. Hg; L.E., 50 mm. Hg. The patient was placed on pilocarpine five times daily and one week later the intraocular pressure in the left eye had dropped to 23 mm. Hg. In December, 1951, intraocular pressure was 23 mm. Hg in each eye. Vision was 20/30 in each eye with correction.

The patient was maintained on pilocarpine twice a day in the right eye, four times a day in the left eye. Throughout the year, 1952, the vision remained 20/25 in the right eye but decreased due to the cataract in the left eye. In January, 1953, vision with correction with the right was 20/30+, with the left 20/100 and no improvement with lens. Intraocular pressure was 23 mm. Hg in each eye.

On January 27, 1953, iris inclusion, anterior sclerectomy and cataract extraction were performed on the left eye. During the hospital stay the anterior chamber remained quiet and following the discharge the anterior chamber reformed but it was noted the pupil was partially drawn up. A drainage bleb was almost immediately noted after discharge from the hospital. In March, 1953, the best correction of the right eye was 20/20, of the left 20/30+; intraocular pressure, 20 mm. Hg in each eye. Pilocarpine was stopped in the right eye and used twice a day in the left eye.

In October, 1953, the vision of the right eye was 20/25 and the left 20/70 with the best correction. The pupil of the left eye was drawn up, leaving only a small chink superiorly at the 12-o'clock position; the intraocular pressure was 18 mm. Hg in the right and 24 mm. Hg in the left. The pilocarpine was reduced to nightly only in the left eye and in March, 1955, vision in the right was 20/30 and in the left 20/200. The last visit in June, 1955, showed the vision to be right eye

20/20+, left eye 20/100; intraocular pressure right and left was 15 mm. Hg.

CASE 7

Mr. E. P., aged 75 years, was first seen in June, 1951, with a diagnosis of glaucoma having been made three years prior to this visit. Advised to have surgery due to loss of control of intraocular pressure. Best corrected vision was right 20/70 and left 20/100-. Despite the fact that patient was on both eserine and pilocarpine five times a day, intraocular pressure was 40 mm. Hg in the right and 46 mm. Hg in the left. Anterior chambers were very shallow and lenses moderately opaque. A dull red reflex was present but no fundus details could be seen.

On June 5, 1951, a cataract extraction with anterior sclerectomy and iris inclusion was performed on the left eye. The lens capsule was ruptured at the operation. A grayish mass of soft lens material was seen in the pupil after extraction. The patient was discharged eight days following surgery. On June 20th the tension of the left eye was felt to be normal by palpation, the tension of the right was 40 mm. Hg. On June 23rd the tension of the right eye was 35 mm. Hg. On June 27th the vision in the right eye was 20/100 and the vision in the left light projection. Intraocular pressure was 30 mm. Hg in the right and 23 mm. Hg in the left.

In September, 1951, vision was 20/100 in the right eye and the left eye was hand movements. Intraocular pressure was: R.E., 20; L.E., 25 mm. Hg. The patient was on Mecholyl (five percent every two hours) in the right eye. In November, 1951, best vision in the right eye was 20/200+2; left eye, hand movements at two mm. Intraocular pressure was 26 mm. Hg right eye and 23 mm. Hg left eye. At that time medication had been one drop of DFP in the left eye in the morning and one drop of Mecholyl (five percent) every two hours in the right eye.

CASE 8

Mr. H. C., aged 77 years, was first seen January 2, 1951, with a history of poor vision with the left eye all his life and failing vision with the right eye since December, 1949, when he had an attack of pain and vision became blurry. Vision was: R.E., 20/50; L.E., 20/100. Fields were moderately constricted with enlarged blindspots. Tension was: R.E., 40 mm. Hg; L.E., 35 mm. Hg. Pilocarpine was prescribed and tension fell five points in each eye by another two weeks and vision improved to R.E., 20/30. For the next 10 months tension ran an uneven slightly elevated course with irregular use of the drops by the patient. Vision had dropped to 20/70 with the right eye and peripheral fields became narrower. Tension was: R.E., 40; L.E., 35 mm. Hg. Pilocarpine was prescribed and tension fell five points in each eye by another two weeks and vision improved to 20/30. One month later the vision had dropped to 20/70 with the right eye and peripheral fields became nar-

power. Tension was: R.E., 38; L.E., 32 mm. Hg. Lens opacities obscured any view of right fundus. On February 21, 1952, the combination operation was done on the right eye with resulting vision of 20/30, with normal tension without the use of miotics. In April, 1953, the vision of the left eye had diminished to counting fingers at three feet due to increasing lens opacities and uncontrolled intraocular pressure. The tension was uncontrolled with the use of miotic drops. The combination operation was performed on the left eye on April 21, 1953, with no improvement in vision but normalized tension without the use of miotics. Vitreous hemorrhage was found.

CASE 9

Mrs. M. G., aged 76 years, was first seen November 21, 1951. She had had scarlet fever with mastoiditis as a child at seven or eight years of age complicated by loss of hearing and right-sided facial paralysis. She had been taking insulin for one and one-half years for diabetes. There was a very lax right lower lid due to the facial paralysis, with tearing. Tension was elevated in the right eye (40 mm. Hg) with dense nuclear sclerosis of the right lens; vision was counting fingers at six feet. Vision of the left eye was 20/70 due to nuclear sclerosis; normal tension. Fields (10/330) were difficult to obtain on account of the deafness but showed about 20 degrees constriction of the right and possibly slight constriction of the left. Pilocarpine and DFP were prescribed for the right eye and on December 3, 1951, a Kuhnt-Szymansky operation was done on the right lower lid, and on February 23, 1952, the combination operation was done on the right eye with resulting vision of 20/30+ and normal tension without miotics.

CASE 10

S. K., aged 76 years, was first seen April 9, 1941, with a history of glaucoma for 12 to 14 years with enucleation of the right eye in 1951 for absolute glaucoma. The patient had been under treatment for glaucoma for several years, using miotics; there was a nasal step in peripheral field. Vision of the left eye was gradually getting worse, 20/100. Nuclear sclerosis of the lens of the left eye prevented a view of the fundus. A combination operation was done on April 23, 1952, with final vision of 20/25 and normal tension without drops up to the present.

CASE 11

Mr. H. R., aged 78 years, was first seen on May 11, 1953, with a history of removal of the left eye for glaucoma in 1951, after a year of pain and inflammation. The vision of the right eye had been fairly good until the last six weeks when the vision began to fail (10/200). He had been using pilocarpine three times daily for several years. Tension of this eye was 40 mm. Hg and the field very moderately constricted. The lens nucleus was moderately opaque and the fundus

not seen. The anterior chamber was of moderate depth. The combination operation was performed on May 12, 1953, and on June 8, 1953, the vitreous was somewhat hazy but the nervehead could be seen and was quite atrophic. I had had word from his local oculist that his tension had been normal without miotics and vision had remained stationary, 20/200.

CASE 12

Mrs. B. H., aged 76 years, was first seen February 9, 1953, with a history of vision of 20/25 with each eye two years previously. The right eye had remained approximately the same but there had been a gradual loss of vision with the left eye to counting fingers at two feet. There were early cortical lens changes in the lens of the right eye but an almost mature cataract was present in the left eye. Tension was normal to fingers before and after mydriasis with Cyclogyl. Peripheral field of right eye normal, left eye constricted about 15 degrees (10/330). She was given Dionin for use nightly at home. Three months later on May 23, 1953, she returned with a history of several attacks of redness of the left eye with tenderness, irregularly dilated fixed pupil, some ciliary congestion, and some superficial corneal edema. Tension was: R.E., 22; L.E., 47 mm. Hg. Miotics and a retrobulbar injection of procaine HCl with adrenalin were given for the left eye and Diamox given internally. She was sent to the hospital where the combination operation was performed on the left eye with subsequent vision of 20/50 and an enlargement of the peripheral limits of the field (3/330) which was quite full to 10/330. A few months later she developed a mild uveitis which cleared up after the extraction of several infected teeth and treatment with intravenous typhoid vaccine (antigen H). A secondary membrane developed and on June 8, 1953, a Wheeler discussion was done transversely with final corrected vision of 20/25 and normal tension with occasional use of miotics for a short time postoperatively only.

CASE 13

Mr. J. P., aged 71 years, was first seen May 4, 1953, with a history of having had an operation on the left eye 20 years before for glaucoma with no vision since. Nine years previously he had an operation for glaucoma on the right eye. Cataract operation had been planned and then postponed twice on account of inflammation and adhesions. The vision was right eye counting fingers at two feet and left eye no light perception. Right eye showed a dull red reflex, many posterior synechias of iris border, with shallow anterior chamber. Left eye showed glaucoma with an opaque, edematous and vascularized cornea and a surgical iris coloboma up and nasally. The lens was partially calcified and subluxated; tension was 45 mm. Hg. Enucleation of the left eye was done May 6, 1953, and the combination operation on the right eye June 27, 1953. The capsule ruptured on attempted

removal and considerable soft lens matter was retained after irrigation. Three months later a dissection was done on the membrane with a good opening. There were many vitreous opacities present and the best vision was 10/200. Tension was 20 mm. Hg without miotics.

CASE 14

Mrs. G. M., aged 64 years, was first seen in 1948 with a history of glaucoma in the left eye for 16 years. The right eye had been injured at nine years of age with poor vision in this eye ever since. The anterior chambers were shallow and there was severe corneal scarring in the right eye. There had been a glaucoma operation on the left eye several years previously. There was an iridectomy, and a filtering bleb above (trephining?). In October, 1953, she had an attack of acute congestive glaucoma right eye, with tension of 55 mm. Hg and vision greatly reduced, hand movements at three feet. She was given a retrobulbar injection of novocaine and dibenamine was used with some relief. The day following the acute attack, the combination operation was done on the right eye and subsequently the tension was quite low. She had a leaky wound above and a bleb of vitreous poked through the wound above which was only partially covered by conjunctiva. Six months later (June, 1954) the bleb had increased in size and a conjunctival flap was drawn down over the wound with satisfactory closure. No miotics were necessary postoperatively to maintain normal tension and the vision on September, 1954, was 20/70.

CASE 15

Mrs. M. S., aged 73 years, was first seen on January 5, 1955, with the history of having had cataracts for several years. The vision had been failing in the left eye and she had had some pain in the eye especially on lying down for several weeks. Vision was: right eye 20/25, left eye 20/100. The anterior chamber angle was quite narrow on gonioscopy especially in the left eye. The right optic disc could be seen and was normal while the left could not be seen on account of lens opacities. Tension right eye 35, left eye 45 mm. Hg. Pilocarpine (two percent) was prescribed every three hours in each eye, which brought the tension down to right eye, 18 mm. Hg and left eye 20 mm. Hg. On January 14, 1955, the combination operation was done on the left eye during which the lens capsule ruptured. The anterior chamber remained flat for 11 days so a paracentesis was done and air inserted. The iris fell back to its normal position and remained there. There were some strands of vitreous still in contact with the cornea in the upper portion and the tension remained up and vision less than 20/200. On March 4, 1955, a cyclodiatery was done on the left eye and air inserted into the anterior chamber. The air separated into many small bubbles in the anterior chamber, indicating the presence of vitreous. The tension of the right eye

became suddenly elevated, 70 mm. Hg, with a steamy cornea while she was in the hospital and was not relieved by Diamox and local treatment. A cyclodiatery was done on this eye on March 7, 1955. The subsequent course of each eye has been satisfactory with use of pilocarpine being gradually reduced to once at night. Tension is under control and vision: right eye, 20/30+; left eye, 20/30+. She had a very high degree of astigmatism in the left eye, the lens required being +10D. sph. \odot +10D. cyl. ax. 175°.

CASE 16

Mr. L. E., aged 75 years, was first seen January 30, 1954, with a history of having had an operation for cataract of the left eye eight years previously with good vision in this eye since. Vision of right eye had been very limited for several years due to cataract formation. One week prior to his visit while sitting reading a paper one evening, he had a sudden pain in the right eye which became very severe and was accompanied by nausea. The vision was right eye, poor light projection, left eye, 20/20— (with correction). There was considerable inflammation of the right eye with steamy cornea and the anterior chamber was filled with glistening crystals. No deposits on posterior corneal surface and no convection currents. The pupil was mid-dilated and fixed. Tension was over 60 mm. Hg. He was sent to the hospital and the combination operation was done the following day. When the anterior chamber was opened, the crystal-filled aqueous escaped and the lens seemed grossly to be intact. The erisophake was applied and the lens was removed. After the extraction, as the lens was held on the erisophake, the milky fluid within was gradually sucked up, finally leaving only the brown nucleus within the capsule. There was undoubtedly a very small hole in the anterior capsule through which some of the fluid contents with its crystals had originally escaped into the anterior chamber and the remaining portion was gradually sucked out by the erisophake. The subsequent course was rather stormy, the eye remaining red and the vitreous cloudy for about two months. The tension continued to be normal and the final vision was 20/25+. The field of the right eye was constricted to 20 degrees up and nasally and down and nasally and 65 degrees temporally (3/330).

CASE 17

Mrs. E. C., aged 65 years, was first seen in June, 1952, with a history of having had an operation on the right eye in 1927 for glaucoma and in 1934 for cataract. She was using pilocarpine three times a day in each eye. Vision was right eye counting fingers at three feet, left eye 2/200. In the right aphakic eye there was a secondary membrane with some encapsulated soft lens matter in the temporal part of the pupillary area; fundus not seen. Tension, right eye, was 30 mm. Hg. Field was limited to about 20 degrees (10/330). The left eye showed a shallow anterior chamber, pupil irregular,

posterior synechias, dense nuclear sclerosis of the lens; fundus not seen. Tension: 35 mm. Hg. Peripheral field limits 30 degrees to 50 degrees (3/330). In April, 1954, anterior capsulotomy was done on the right eye and at the same time the combination operation was done on the left eye and since then the tension has been normal in the left eye without miotics. Vision, left eye, was 20/30 eight months later when last seen and the field of each eye had enlarged.

CASE 18

Mrs. K. D., aged 69 years, was first seen May 3, 1954, with a history of poor vision with the right eye for the past five years, and with the left eye for two years. The vision of the right eye had always been poorer than the left eye. A sister had cataract and glaucoma and her mother and grandmother had cataracts. Best vision at the first visit was right eye counting fingers at six feet and left eye 20/100. Pupils were normal. Lens opacities were present in each eye. In the right eye there was a small (two mm.) densely white anterior polar disc-shaped opacity just under lens capsule (congenital?). There was nuclear sclerosis with many radiating cortical opacities. Left eye, nuclear sclerosis and cortical opacities less than the right eye. Fundi were indistinctly seen under Cyclogyl mydriasis and no pathology noted. Tension was: R.E., 37; L.E., 30 mm. Hg. Fields showed 10 to 15 degrees of constriction for each eye (3/330). On May 5, 1954, the combination operation was done. This was followed by considerable reaction with much edema of the conjunctiva of the lids. The anterior chamber was reformed on the third day. In one month the vision was 20/30 and it later improved to 20/20. There was a good filtering bleb above. Tension remained low for 11 months until her decease April 3, 1955.

The patient felt some confusion of vision on account of the blur of the vision of the left eye interfering with the right eye and, as the tension in this eye had never been above 30 mm. Hg (23 on the last examination), a combination cataract extraction was done with complete basal iridectomy tearing the iris from its root in the area of the coloboma. The patient did well for three days when

suddenly at 11:00 A.M. she complained of rather severe abdominal pain which became worse during the day with little change in temperature, pulse, or respiration until late in the day. Blood count of 10,000 white cells per cc. (65 percent polymorphs) with shift to the left as compared to the admission blood count (38 percent stab forms later, 2:00 P.M., as compared to three percent on admission). She died at 5:00 A.M. the next morning after going into a state of complete shock about 2:30 A.M. Autopsy revealed very little to account for her decease. There was an acute inflammation of the large bowel with ulceration of the mucosa and lymphocytic infiltration.

The eyes were removed and the right cornea was used for a corneal transplantation while the left one was found to be unsuitable. The pathologic report showed functioning cystoid scars (figs. 6 and 6A). "There is an opening between the margin of the cornea and the sclera through which a section of iris passes in contact with the sclera. Overlying this area is intact conjunctival epithelium. In the opposite anterior chamber angle there are peripheral anterior synechias. In the center of the cornea there is a space from which the section of cornea had been removed for use for a corneal transplant." In the illustration of the higher magnification it is seen that the iris had been torn away from the ciliary body (fig. 6A).

CASE 19

Mrs. D. S., aged 78 years, was first seen in 1931 for acute conjunctivitis and dacryocystitis for five months. Vision was right eye 20/20 and left eye 20/15. It was noted that the anterior chambers were shallow and there was slight pallor of the nerve-heads. Her next visit nine years later, October 21, 1940, was occasioned by intense pain in the head and eye for two weeks previously with nausea and vomiting. Pupils were dilated and fixed, cornea edematous. Tension was right eye 90 and left eye 70 mm. Hg. Vision was reduced to 10/200 in each eye. She had recently been treated by "electricity." Fields were slightly contracted. Miotics reduced the tension somewhat: right eye, 42, left eye, 40 mm. Hg.

A trephination was done on the right eye October 31, 1940, and on the left November 6, 1950, with

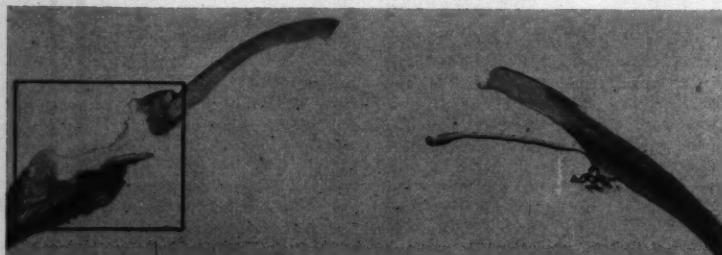


Fig. 6 (Hughes). Cross section of eye removed at autopsy one year postoperatively. Section of cornea used for a transplant.

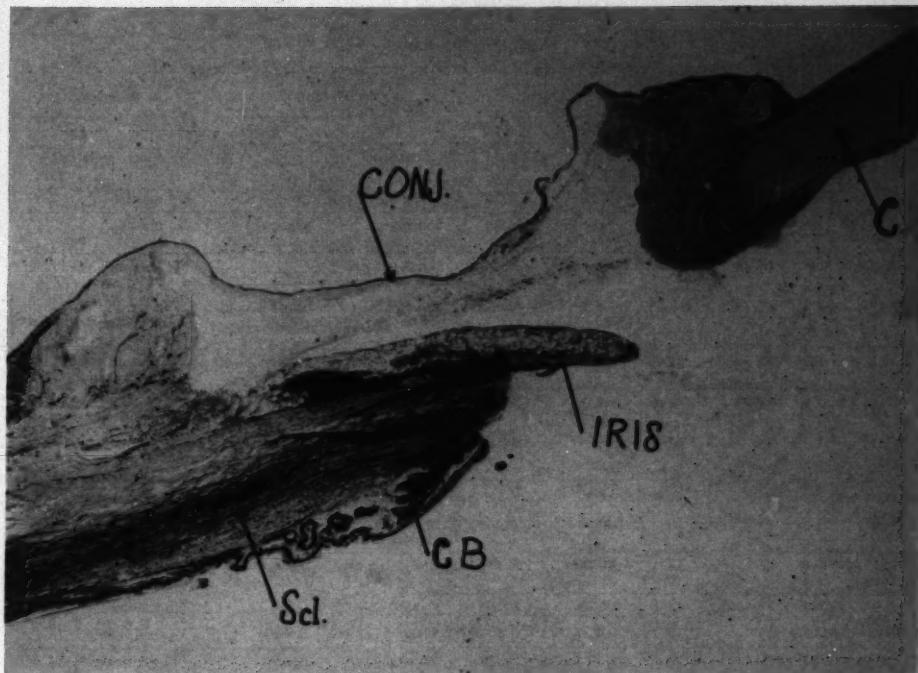


Fig. 6A (Hughes). Magnification of filtering wound showing iris wick lying on sclera in sclerectomy opening. This section was taken in a place where the iris was torn from its root.

resulting vision of 20/70 and 20/100 and normalized tension. She was seen again October 1, 1954, with vision greatly diminished: right eye, counting fingers at six feet and left eye, hand movements at three feet. She was very frail. The right field was fairly full by confrontation but there was only a small upper temporal quadrant remaining in the left eye. There was marked sclerosis of the lens nuclei. A combination operation was done on October 20, 1954, on the right eye with resulting vision of 20/70. Normal tension without miotics and the field could only be estimated on account of the extreme frailty of the patient.

CASE 20

Mr. D. H., aged 82 years, a frail man, was first seen in consultation November 1, 1954, with the history of having been treated for glaucoma for six years. About one year ago he was told he had a cataract formation. His vision was right eye 20/200 and left eye counting fingers at five feet. Both anterior chambers were quite shallow with some peripheral anterior synechias, especially in the right eye. There were many pigment granules in the anterior chamber angle seen on gonioscopy. Fundi were poorly seen on account of lens opacities and small pupils, although some red reflex was

visible. The tension was right eye 34 mm. Hg; left eye 23, under pilocarpine. On November 5, 1954, the combination operation was done on the right eye with resulting normalization of tension. The anterior chamber was reformed after three days and the tension has remained normal without the use of miotics. The vitreous was somewhat cloudy, optic nervehead quite pale, and best vision has been

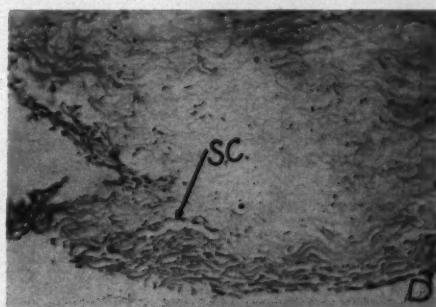


Fig. 7 (Hughes). Section of a piece removed for sclerectomy showing Schlemm's canal and the breaking up of Descemet's membrane.

TABLE 1
SUMMARY OF CASES

Name	Age (yr.)	Eye	Tension		Vision		Fields		Remarks
			Pre	Post	Pre	Post	Pre	Post	
T. B. May '31	63	RE	20-40	20	20/100	20/15	Unchanged		No miotics postop.
Oct. 31		LE	20-40	20	20/70	20/15	Unchanged		No miotics
B. K. 1-30-52	77	RE	90 Acute	20	Light Proj.?	20/40	Some gen. cons. grossly	Same	No miotics
B. F.	68	LE	20-48	23	Light Proj.?	Phthisis bulbi	Nasal constr. 8 deg.		No miotics
5-23-47		RE	20-40	18	C.F. 6'	20/30+	Full field	Slight constr. above	Bilateral ant. sclerectomy and iris inclusion 8 months before
M. C. 1-24-48	72	LE	20	23	5/200	20/30	Full to light?	Constr. 30-40	No miotics. Glaucoma 14 yr.
F. W. 1-6-50	61	RE	35-55	20-23	C.F. 3'	20/15	Slight constr. 50-70	Improved slightly	No miotics. Prev. trephine. Extracaps.
5-21-51		LE	30	20-23	20/70	20/20	Constr. to 40- 50	Improved slightly	No miotics. Prev. trephine
W. B. 6-11-51	66	RE	55	25	20/100	20/20	Some constr. Bjerrum Scot	Enlarge periph. Bjerrum Scot	Miotics for a time. Air in- to A.C. for flat chamber
1-27-53		LE	55	20	20/70	20/70	Marked constr.	Same	Miotics for a time
E. P. 6-5-51	75	LE	46	23	20/100	H.M. 6'	Constr. nasally	Same	Extracaps. Sec. Mem. mi- otics
H. C. 2-21-52	77	RE	38	15	20/70	20/30	Constr.	Same	No miotics
4-21-53		LE	37	18	C.F. 6'	C.F. 6'	Marked constr.	Same	Vitreous hem.
M. G. 2-23-52	76	RE	40	20	C.F. 6'	20/30+	Constr.	Same	No miotics
S. K. 4-23-52	76	LE	23	23	20/200	20/25	Nasal step	Same	No miotics
H. R. 5-12-53	78	RE	40	25	10/200	20/200	Mod. constr.	Same Opt.	No miotics
B. H. 5-25-53	76	LE	47	15-20	C.F. 2'	20/25	Const. 20 deg. +	Improved to full field	Miotics for a short time only
J. P. 6-2-53	71	RE	30	20	C.F. 6'	10/200	Fairly full to light	Fairly full to 25/330	Extracap disciss. No mi- otics
G. M. 10-53	64	LE	18-55 acute glaucoma	18	20/200	20/70	Constr.	Same	Repair of leaky wound. No miotics
M. S. 1-14-55	73	LE	53	23-40	20/100	20/30+	Very constr.	Same	Extracap. Flat A.C. and infected. Cyclo-diath.
L. E. 1-31-54	75	RE	60+	23	Doubtful light proj.	20/25+	Poor light proj.	Marked con- str. nas. to 25 deg.	Spont. rupt. of lens. No miotics
E. C. 4-54	65	LE	20-35	15-23	20/200	20/30	Constr. to 30- 50 deg.	Same	No miotics
K. D. 5-5-54	69	RE	37	10-18	C.F. 6'	20/20	10-15 deg. con- str.	Same	No miotics
D. S. 10-20-54	78	RE	32 Prev. trep.	17-20	C.F. 6'	20/70	Fairly full by confrontation	Same	Optic atrophy. No mi- otics
D. H. 11-5-54	82	RE	34	13	20/200	10/200	Nasal constr.	Same	No miotics
1-18-55		LE	23	13	C.F.	8/200	Nasal constr.	Same	No miotics
M. H. 1-14-55	70	LE	45	23	H.M. 3'	20/50	Nasal field con- str. 10 deg.	Slightly more constr.	Diabetic. Extracap. Sec. Mem.
A. B. 4-24-57	72	RE	23	18	20/200	20/100	Very small 5 deg.	Same	2 treph. & iridenclesis. E.E. Pilo
		LE	25	20	H.M.	H.M.	Very small 5 deg.	Same	No miotics

CATARACT WITH GLAUCOMA

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TABLE 1 (Continued)

Name	Age (yr.)	Eye	Tension		Vision		Fields		Remarks
			Pre	Post	Pre	Post	Pre	Post	
G. K. 11-21-56	45	LE	40	14	20/100	20/30	Normal	Same	Retina detached 2 mos. Postop. No miotics
E. R.		LE	23	20	20/100	20/70	Normal	Same	Hem'ge in macula. No miotics
J. C.	53	RE	60	35	20/50	10/200	Sl. constr. upper	Same	Subsequent operation necessary
1- 9-58		LE	50	23	20/50	20/30	Sl. constr. upper nasal	Same	Normal. No miotics
A. V. ^a 5- 3-57	73	RE	35	20	20/70	20/100 4 mos. later	Const. above	Same	Massive vit. hem. Later enucleation. No miotics
1-17-57		LE	45	18	20/100	20/30	Const. above	Same	No miotics
P. R.	62	RE	25	23	20/100	20/	Sl. const. above	Same	No miotics
4-20-56		LE	30	23	20/200	20/200	Sl. const. above	Same	Macular hem'ge, vitreous hem'ge. No miotics
G. K. 4-12-57	72	RE	45	15	10/200	10/200	Loss lower nasal field	Same	No miotics
4-23-57		LE	65	15	20/100	20/50	Const. 20 deg.		No miotics
M. J. 3- 5-57	85	LE	70	7	H.M. lower field	C.F. 1'	Loss upper field	Same	Macular degeneration. No miotics
P. R. 10-23-56	73	RE	35	15	6/200	5/200	Upper temp. cut	Same	Intracapsular. No miotics
10-12-56		LE	45	15	10/200	20/200	Const.	Same	Extracapsular. No miotics. Sec. memb. dissection, no miotics
I. B.	50	LE	37	27	H.M.	C.F. 2'	Light proj.	Same	Cornea opaque. Pilo.
S. C. 10-30-56		LE	23	20	20/100	20/20	Enlarged. Bl. spots	Same	Prev. operation for glaucoma (7 yr. prev.). No miotics
B. H. 5-25-53	74	LE	47	12	C.F. 1'	20/25	Light proj. poor	Same	Cupping of disc
K. M. 10-10-56	78	RE	23	12	C.F. 2'	Same	Poor field		Optic atrophy
10-21-55		LE	16	15	Light proj.	20/25	Constr.	Same	Disc pale
F. K.	86	LE	35	13	L.P. doubtful	20/100	L.P. poor nasally	Nasal 1/2 field gone	No miotics
E. S. 9-11-57		LE	20/200	20/30	34	23	Sl. const. above	Same	No miotics
M. F. 5-20-53		RE	20/100	20/50	30	23	Sl. const. above	Same	
1-10-58		LE	20/200	20/20	25	23	Sl. const. above	Same	Trehpine 1-29-57
T.		LE	L.P. doubtful nasally	20/30	23	20	Nasal field down to 20 deg.	Same	No miotics
N. M. [†] 2- 2-56	30	RE	H.M.	20/60		19	—		Severe bilateral uveitis with sec. glaucoma and complicated cataracts. Cycloidalysis also done. No miotics
M. P. 1-10-58	54	RE	20	15	20/200	20/50	Full		Prev. successful trephine. Vit. hemorrhage
4-20-56		LE	20	15	20/100	H.M. 7'	Constr. 20 deg.	2 yr. postop.	Cyclo-electrolysis. Vit. nasal cut to 10 hemorrhage deg.
J. D. 1957	82	RE	45	19	C.F. 1'	20/400?	None	None	Pt. had choroidal detachment and cleared 6 wk. postop. Died 4 mo. postop. No drops or Diamox
F. S.	66	RE	34	30	LP & P	20/50 — & cc.	None	None	Hyphema. Vit. bulge in ac. Thin layer of hem. lower portion. No Diamox or drops

^a Operated by Dr. R. Copeland.
[†] Case of Dr. P. Robb McDonald.

10/200. Fields were very difficult to obtain on account of the frailty of the patient but there was apparently considerable loss of the upper field of the right eye with a fairly full field on the left. On January 18, 1955, the same operation was performed on the left eye with a similar result. The tension of this eye remained low without miotics. There was a severe optic atrophy and vision was not improved over 8/200.

CASE 21

Mrs. M. H., aged 70 years, was first seen December 29, 1954, with a history of diabetes and poor vision for two years. She had been referred by another oculist who had been treating her for cataract for some time. One year previously and intermittently in the past six months she had had redness and pain in the left eye. Two days ago the vision became suddenly blurry with increased intraocular pressure. Pilocarpine had been used for two days and the tension was normal (R.E., 22 mm. Hg; L.E., 20 mm. Hg) in each eye when first seen. Examination revealed vision of 20/40 with each eye, shallow anterior chambers, moderate lens opacities. Right field was normal and the left markedly constricted down to five degrees nasally and to 60 degrees temporally (3/330). Pilocarpine was continued three times daily in the left eye and at night in the right.

Twelve days later she returned with a very painful red left eye starting eight hours prior to her visit. The left cornea was edematous, pupil mid-dilated and fixed, vision left eye hand movements, and tension 90+ mm. Hg. She was given a retrobulbar injection of novocaine, adrenalin, pilocarpine, and eserine drops and placed on Diamox and sent to the hospital. The pressure came down and three days later the combination operation was done (January 14, 1955). The capsule ruptured during delivery of the lens. She had a shallow anterior chamber for three and one-half weeks when air was inserted which resulted in reformation of the cham-

ber. There was a secondary membrane and a drawn-up pupil. Vision was 20/50. Field slightly smaller than preoperatively. Tension has remained between 16 and 23 mm. Hg since the operation. A discussion with incision of the iris sphincter is contemplated at a later date.

SUMMARY

1. A procedure for the removal of cataract in combination with anterior sclerectomy and iris inclusion has been described.

2. An analysis of the results of the combination operation in nearly 60 eyes is presented:

a. All but four of these cases had restoration of normal tension without use of miotics postoperatively.

b. No further loss of vision due to continued uncontrolled tension occurred in any case.

c. One eye was lost in this series from a vitreous hemorrhage occurring several weeks after the operation.

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I wish to acknowledge help in the analysis of the case reports by Dr. Jack Gans, my secretaries under the direction of Miss Mary Ketcham, and the kindness of Dr. Peter H. Ballen, Dr. P. Robb McDonald, and Dr. Robert L. Copeland in allowing me to use the reports of their cases in this report. Also my acknowledgment to Dr. C. C. Teng for his very nice slides and pathologic analysis of the slides and to Dr. J. A. de Veer for his excellent analysis of the small sections of the sclerectomy specimens and photographs of the same.

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THE SURGICAL SEPARATION OF THE CORNEOSCLERAL TRABECULUM FROM ITS BED*

II. POSTERIOR TRABECULODIALYSIS

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In Part I of this paper a surgical procedure was described by which the corneoscleral trabeculum is detached from its bed using a specially angulated spatula. In this previous procedure the corneoscleral trabeculum was approached from the anterior chamber, therefore the operation was termed anterior trabeculodialysis. In further experiments a different approach was employed.

TECHNIQUE

For the present investigations, presumably normal eye-bank eyes were used, and were handled and treated preoperatively in the same way as described in detail in Part I of this paper. The angulated spatula which was used for the operation of the anterior trabeculodialysis was employed in about one half of the operations in this series. The remaining operations were performed with an identically angulated instrument which, however, had a much thinner blade (spatula proper) and thinner active edge.

Since the operations with both these instruments were performed with the same technique and the results were similar both groups are reported together.

OPERATION

The eye was positioned so that the quadrant of the eye which was to be operated was that farthest from the surgeon on his right side (fig. 1-B). This position was the standard in every operation described below and was consistently obtained by rotating each eye as necessary.

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1. A 2.0-mm. long scleral incision, 3.0 mm. from and parallel to the limbus, was made at the 3-o'clock meridian (fig. 1-b).

2. The sclera was marked with the heated tip of a strabismus hook 3.0 mm. from the limbus at the meridian which approximately halved the quadrant to be treated (fig. 1-m).

3. The handle of the angulated spatula was tilted to the left at a 45-degree angle to the vertical while the blade of the spatula was being introduced through the scleral incision into the subchoroidal space with its flat surface parallel to the sclera. The tip of the blade was pushed slowly toward the mark m (fig. 2) so that its medial-facing the cornea—edge was approximately 3.0 mm. from the limbus. During this manipulation the instrument was being pulled gently and firmly away from the eye so that the blade glided snugly under the inner surface of the sclera avoiding injury to the ciliary body.

4. After the tip of the blade had just passed the mark m the handle of the instrument was turned into the erect position, given by a straight line passing through the handle and the shaft of the instrument and the center of the eye. At this position the flat surface of the blade formed a 45-degree angle with the inner surface of the sclera, was positioned tangentially to the circular corneoscleral trabeculum and about 1.5 to 2.0 mm. from it, and only its left edge was in contact with the inner surface of the sclera (figs. 2 and 3). The handle, being pulled firmly but gently away from the eye, was slowly rotated to the left so that the blade performed a slow sweep toward the angle of the anterior chamber until its tip became visible through the cornea. During this manipulation the left edge of the blade gently scraped the inner surface of the sclera and the corneoscleral junction. The blade was

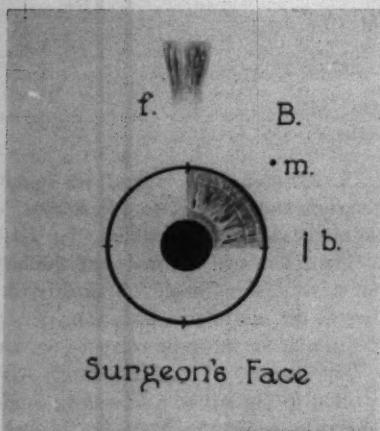


Fig. 1 (Dellaporta). The proper position of the eye and of the surgeon during the operation. (B) Quadrant of the eye which is to be treated; note its position in relation to the face of the surgeon. (b) Scleral incision. (m) Mark on the sclera 3.0 mm. behind the limbus and approximately at the meridian which halves the quadrant (B). (f) Fixation of the eyeball.

then slowly withdrawn until its tip disappeared under the limbus (fig. 2-B).

5. The handle of the instrument was tilted again to the left as in the first stage (under paragraph 3) of the operation and the tip of the blade pushed toward and just inside the mark m until reaching a position where the whole quadrant was within its radius (fig. 2-C). The handle was then turned into the erect position as in the first stage of the operation and the second sweeping movement

was performed as described above (under paragraph 4) until the tip of the blade appeared in the anterior chamber, whereupon the spatula was finally withdrawn.

During the entire operation the eye was fixed with a forceps grasping the insertion of the rectus muscle lying opposite the surgeon at the 12-o'clock position (fig. 1-f).

HISTOLOGIC RESULTS

Sixty-three operations were performed with the above-described method and were studied in serial meridional sections stained with hematoxylin-eosin or Masson's trichrome stain.

In four of the operations (six percent) the results were negative, that is, the outer one third to one half of the trabeculae were found in their normal position covering Schlemm's canal, whereas the remaining trabeculae had detached and were found clinging to the separated ciliary body. Thus, Schlemm's canal remained anatomically closed (fig. 4).

The remaining 59 specimens (94 percent) showed the following (figs. 5 to 10):

Descemet's membrane and the corresponding endothelium was found detached in the area of the operation in a width of about 1.0 to 3.5 mm.

The corneoscleral trabeculum had detached from its bed and remained clinging to the separated anterior segment of the ciliary body. Consequently, Schlemm's canal

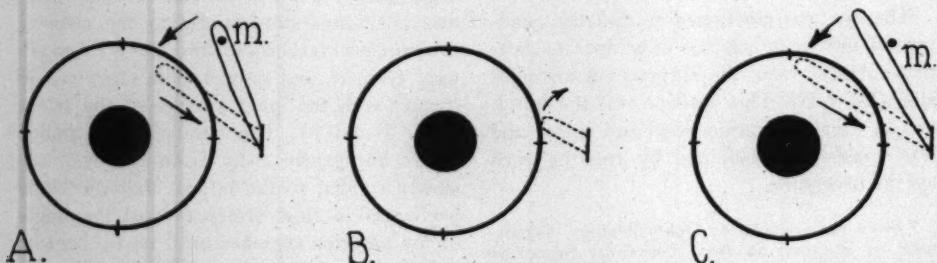


Fig. 2 (Dellaporta). Shows the successive steps of the operation. Position of the blade of the angulated spatula before the first sweep (A) and before the second sweep (C). Dotted line indicates how far the blade of the spatula is rotated anteriorly into the anterior chamber.

opened into the anterior chamber, its outer wall with its structures being in direct contact with the aqueous humor. In the great majority of the cases the endothelium lining the outer wall of Schlemm's canal was found in good condition.

The *scleral spur* had in many cases separated from the sclera and remained attached to the base of the detached corneoscleral trabeculum; in several cases it was found in its normal position and in the remaining instances it was histologically not visible.

The *ciliary body* showed limited separation from the sclera measuring approximately 3.0 mm. in width.

Thus, with this method the corneoscleral trabeculum was detached from its bed in 59 (94 percent) out of a total of 63 operations, leaving Schlemm's canal to communicate freely with the anterior chamber. For this procedure the term *posterior trabeculodialysis* is suggested.

COMMENT

The angle at which the blade of the spatula will approach the corneoscleral trabeculum from behind and will detach it from its bed is, in this procedure just as in the operation of

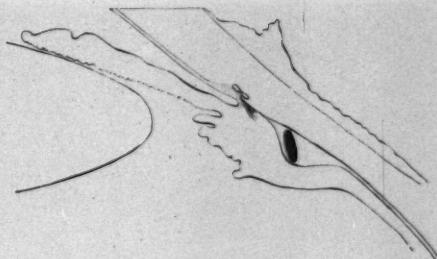


Fig. 3 (Dellaporta). The position of the blade of the angulated spatula before treating the corneoscleral trabeculum.

anterior trabeculodialysis, the essential factor for a successful operation.

It is necessary to position the quadrant of the eye which is to be treated to the right side of the surgeon because this is the most convenient situation for the right-handed surgeon using the angulated spatula described here. The remarks regarding the direction of the angulation of the blade in Part I of this paper on anterior trabeculodialysis are equally valid for this procedure. One could angulate the blade differently in such a way that when the instrument is held in the "standard" position the left edge would be sloping to the left and downward, the

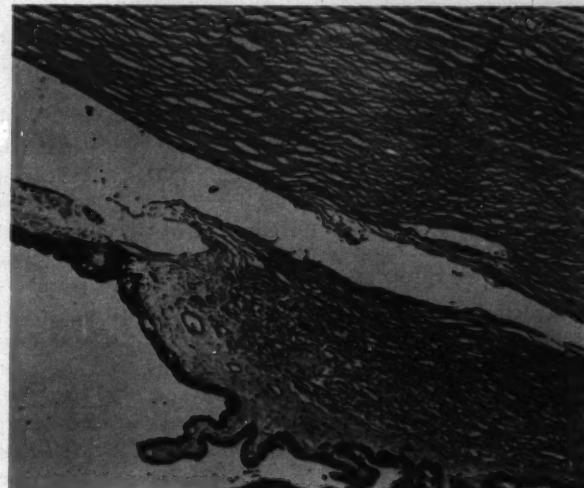


Fig. 4 (Dellaporta). Anatomically unsuccessful operation. About one-half of the trabeculae have been detached from their natural bed and are adherent to the anterior end of the separated ciliary body. The remaining trabeculae cover Schlemm's canal.



Fig. 5 (Dellaporta). Successful operation. The corneoscleral trabeculum has been detached from the corneoscleral capsule and is clinging to the anterior end of the separated ciliary body. Schlemm's canal is converted into a narrow, shallow sulcus which forms part of the anterior chamber.

right edge upward and to the right. In this case the sweep would have to be performed to the right which in my experience is an awkward movement for the right-handed surgeon.

The tilted position of the handle of the instrument during the introduction of the blade into the subchoroidal space insures that the blade is in a parallel position to the sclera and the ciliary body so that injury to these structures is avoided.

The proper position of the handle of the instrument during the sweeping movements is essential for the success of the operation, otherwise the active left edge of the blade, being at the wrong angle, will not reach and separate the corneoscleral trabeculum. For

the same reason the instrument must be pulled gently but firmly away from the eye during the sweeping movements. In this technique the actual separation of the corneoscleral trabeculum is usually not felt by the fingers as it is in the operation of anterior trabeculodialysis.

The extent of the first sweep has to be slightly more than one half of the quadrant of the eye so that the spatula will approach the corneoscleral trabeculum tangentially; this seems to be the most advantageous position for a successful operation.

The operation is performed in two separate sweeping movements so that equal chances of success are twice offered.

After each sweep the blade is withdrawn



Fig. 6 (Dellaporta). Detached corneoscleral trabeculum. Above it is the open Schlemm's canal. The resulting sulcus is wide and shallow.



Fig. 7 (Dellaporta). Detached corneoscleral trabeculum. Open Schlemm's canal. The resulting sulcus is relatively narrow and deep and is lined by intact endothelium.

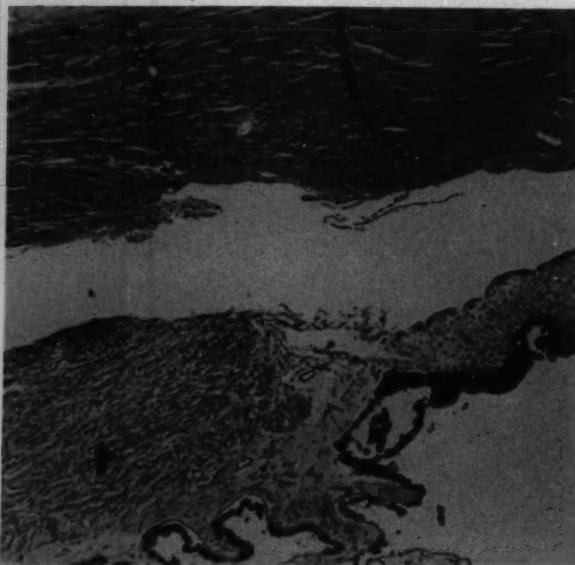


Fig. 8 (Dellaporta). Only a few trabeculae of the detached corneoscleral trabeculum are visible clinging to the ciliary body. Schlemm's canal open.

as soon as its tip appears in the anterior chamber in order to limit damage to the endothelium and Descemet's membrane.

DISCUSSION

It is obvious from these investigations that in both trabeculodialysis operations the prerequisite for the separation of the corneoscleral trabeculum from its bed and the anatomic opening of Schlemm's canal is the angle at which the blade of the spatula will

scrape the inner surface of the corneoscleral junction. One might say that this angle is at least as essential as the angle at which a golf club will hit the ball.

There is no doubt that in performing a cyclodialysis, either the classical one of Heine or von Blaskovics' cyclodialysis inversa and their numerous modifications, some surgeons might accidentally have detached the corneoscleral trabeculum if the instrument was not held in the proper posi-

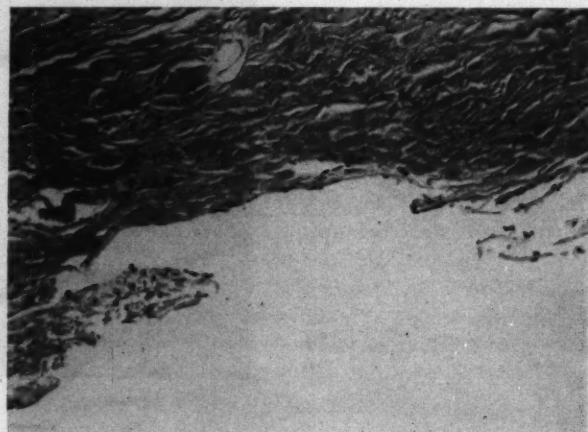


Fig. 9 (Dellaporta). High magnification of Schlemm's canal from Figure 8. Note intact endothelium of Schlemm's canal.

Fig. 10 (Dellaporta). Detached corneoscleral trabeculum hanging on the ciliary body. Relatively deep-set Schlemm's canal. Intact endothelium lining the resulting sulcus.



tion and the blade of the spatula was not parallel to the sclera during the sweeping movements.

It is at present pure speculation to theorize on the effects of trabeculodialysis on the problem of glaucoma. It is probable that these procedures will effect the same anatomic results in living eyes as they do in eye-bank eyes. It is also reasonable to assume that when these operations are used for treatment of living eyes no complications will occur other than those encountered in different types of cyclodialysis. One would rather expect that the complications would be fewer and of lesser degree since the ciliary body is injured considerably less in both types of trabeculodialysis.

As to the immediate effects of the operations, one may reasonably expect a considerable drop of the resistance to the aqueous outflow in normal eyes and, if our present assumption that the corneoscleral trabeculum is the site of increased resistance to the aqueous outflow in glaucoma is true, also in glaucomatous eyes.

Another question arising is whether the

endothelium lining Schlemm's canal and the outflow channels will remain unaltered under the continuous influence of the aqueous humor or will undergo reactive changes which might result in secondary obstruction of the outflow channels. Kronfeld* believes that these structures will remain unchanged since the aqueous humor constitutes their natural medium.

SUMMARY

Anterior and posterior trabeculodialysis are two simple surgical methods by which the corneoscleral trabeculum can be removed from its natural bed and allow Schlemm's canal to communicate openly with the anterior chamber. The methods were developed in normal eye-bank eyes and proved histologically to be successful in 94 to 95 percent in a total of 121 operations. The possible effects of trabeculodialysis in normal and glaucomatous eyes were briefly discussed.

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* Personal communication.

DELAY OF CORNEAL EPITHELIALIZATION IN EXPLANTED EYES WITH ELEVATED INTRAOULAR PRESSURE*

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It is a common clinical observation that a corneal epithelial abrasion in an eye with a markedly elevated pressure does not heal as quickly as a normal eye similarly injured. The present study was devised to learn if there was a causal relationship between an elevated intraocular pressure and failure of small epithelial defects of the cornea to heal normally.

The earliest report concerning corneal epithelial healing is that of Peters¹ who observed that epithelialization occurred as a result of migration and sliding of the epithelial cells to cover the defect and that cell division played only a secondary role. Subsequent workers (Oppel,² Arey,³ and Arey and Covode⁴) have emphasized that cell migration is the chief component in the repair of small epithelial defects and that cellular division exerted a minor and delayed role.

Arey and Covode found, moreover, that mitotic activity of the epithelium is suppressed in both the initial and final stages of the healing process. They found that: (1) the repair of small epithelial defects begins promptly after the injury; (2) during the initial stage of epithelialization the rate at which surrounding epithelial cells enter mitosis falls below the normal rate; (3) that cell division does not occur in the epithelial area being covered.

These observations have been confirmed by Friedenwald and Buschke⁵ and have been reviewed in detail by Thomas.⁶ Sméleser and Ozanics,⁷ however, describe a slight increase in mitotic activity during the healing of small epithelial thermal defects.

* From the Department of Surgery (Section of Ophthalmology), The University of Chicago. This study was aided in part by a grant from the Knights Templar Eye Foundation, Inc., and the L. M. and E. M. Kuppenheimer Fund.

The morphology of the repair of small defects has been described by Friedenwald and Buschke.⁵ Immediately following injury the cell nuclei are arranged tangentially about the periphery of the minute wound. This alignment results from mechanical compression of the cells by the instrument producing the injury and from elastic retraction of the surrounding intact epithelium. According to Mann⁸ the morphologic appearance of the defect once migration is initiated is determined by the original shape of the epithelial defect and neither the shape nor the rate of migration is influenced by the nature of the injury or by the underlying substantia propria. Friedenwald and Buschke⁵ describe the migrating cells as flatter than normal and initially forming only a single layer over the defect.

Following an injury there is a period of one hour during which no apparent migratory activity can be seen. Friedenwald and Buschke have observed that exudate¹⁰ in the defect formed immediately following the injury, and they have suggested that a stimulus for cell migration is established in this period. This exudate is of a lipid nature, and is probably a phospholipid in whole or in part.

Dunnington,¹¹ in studies of wounds of the corneoscleral limbus in the Rhesus monkey and in cats, noted that the initial reactions in wound healing may be mediated by certain catalytic influences of proteolytic enzymes. Furthermore, infiltrating pholymorphonuclear leukocytes, attracted to the site of tissue repair presumably by some chemotactic factor in the wound, themselves liberate proteolytic factors perpetuating this phase of the repair cycle.

Weimar¹² suggests that if there is an essential proteolytic substance required for the

inward migration of polymorphonuclear leukocytes it might be initially activated or liberated by the injured corneal tissue itself. There is evidence that corneal epithelial cells can and do transform into leukocytes and into the keratoblasts taking part in repair of the corneal stroma.¹³⁻¹⁵ Furthermore, Loeb¹⁶ has found that epithelial cells in tissue culture are capable of amoeboid activity, which suggests that the corneal epithelial cells are either entering a preleukocytic phase or are demonstrating the phenomenon of simple migration without transformation into a new cell type.

STUDIES ON THE ISOLATED EYE

The cornea of an isolated eye remains viable for at least 24 to 48 hours. Buschke, et al.,¹⁷ and Marr, Wood and Storck¹⁸ have demonstrated that the corneal epithelium of an isolated eye retains its ability to heal defects made in it, albeit not as rapidly as in the eye *in vivo*.²³ The isolated eye preparation used in this study is that of these workers.

Thirty small punctate corneal epithelial injuries were made with a needle in white female ether-anesthetized rats. (In two animals only 20 injuries were produced.) Each injury was produced with as equal a force and exactness as possible. The eyes were then enucleated and immersed in Sorenson's phosphate buffer (pH 7.2) warmed to 37°C. Each eye was mounted in a special chamber (fig. 1) and was cannulated with a 27-gauge needle inserted into the vitreous cavity through the sclera behind the equator. The preparation was attached to a reservoir-manometer filled with Ringer's solution which was adjusted to the desired height above the level of the eye (the ocular equator was used as the zero mark). The intraocular pressure was the hydrostatic pressure of the system and corresponded to the height (in cm. water) of the reservoir level above the eye. The needle of the control preparation was occluded prior to being inserted into the eye. Both preparations were oxygenated by bub-

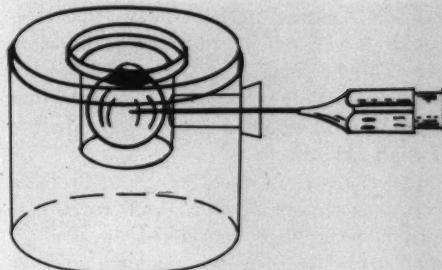


Fig. 1 (Alexander and Newell). Eye chamber used in study. The needle was connected to a manometer.

bling oxygen through the solution which additionally served to circulate the fluid surrounding the eye.

After three hours in the solution the eyes were fixed in alcohol-formalin for 12 to 24 hours. The cornea was then removed from the eye, dehydrated, stained with hematoxylin, and mounted as a flat preparation.

RESULTS

In the normal cornea most cell nuclei of the superficial epithelial layer have a homogeneous ground-glass appearance, but many nuclei, though less than half the total of cells per field, are either stippled or clumped, and occasionally have a fine, foamy appearance. Most preparations show a minimal amount of epithelial edema. In those corneas from eyes with markedly elevated pressure the cell nuclei show variably severe alterations with most nuclei stippled, clumped, foamy, and markedly edematous.

The middle layers of the epithelium show cell nuclei which appear homogenous in the corneas of normal eyes but in eyes with hypertension show varying degrees of stippling. The appearance of the basal layers is similar in both the control and hypertensive eye. Mitoses are found only in the two basal layers.

Among the cells in the basal layer appear varying numbers of "wandering cells." Their nuclei are elongated and sometimes irregular, and they resemble fibrocytes. In

addition, rounded nuclei (darker than epithelial nuclei) and intermediate forms were seen. The distribution of these cells was not correlated with the changes in the intraocular pressure, nor with the presence or absence of epithelial defects.

The diameter of each defect in the basal layer was measured with $\times 430$ magnification. Defects were considered "healed" if completely covered with epithelium, or if the diameter of the unepithelialized area was less than 2.4 microns. Defects with a diameter of more than 2.4 microns were considered unhealed. Each eye with increased pressure was compared with the fellow eye of the same animal.

The results are shown in Table 1. Increasing the intraocular pressure to 45 cm. of water did not modify the number of healed defects in the treated and control eyes. In four pairs of eyes the eye with the increased intraocular pressure had a greater

number of healed defects and in the remaining four pairs the healing rate was the same, or the control eye healed more quickly. The control eyes showed an average of 79.4 percent of the defects healed as compared to 80.4 percent in the eyes with the intraocular pressure increased to 45 cm. of water. In eyes with the intraocular pressure increased to 75 cm. (H_2O), the results were similar to those at 45 cm. In two of the eight pairs of eyes, the eyes with increased intraocular pressure had a greater number of healed defects and in the remainder the control eyes healed more quickly. In four pairs of eyes the treated and control eyes had virtually identical healing rates, and in the two remaining pairs, healing in the eyes with increased pressure was delayed. An average of 73.7 percent of the defects in the control eyes healed in three hours as compared with an average of 67.4 percent of the defects in the eyes with elevated pressure.

TABLE 1
RESULTS OF STUDY

Animal Number	Number of Lesions Healed		Number of Lesions Not Healed	
	Control Eye	Increased Pressure	Control Eye	Increased Pressure
Pressure 45 cm. H_2O				
1	13	15	7	5
2	18	19	2	1
3	19	8	11	22
4	9	17	21	13
5	28	25	2	5
6	25	24	5	6
7	20	28	10	2
8	29	28	1	2
Pressure 75 cm. H_2O				
1	14	22	16	8
2	27	14	3	16
3	24	11	6	19
4	22	21	8	9
5	18	27	12	3
6	24	22	6	8
7	22	21	8	9
8	26	24	4	6
Pressure 97 cm. H_2O				
1	26	6	4	24
2	21	4	9	26
3	28	2	2	28
4	29	13	1	17
5	21	26	9	4
6	21	9	9	21
7	25	14	5	16
8	24	22	6	8

In eyes in which the intraocular pressure was elevated to 97.5 cm. (H₂O) there was a decreased rate of epithelial migration. In one of the eight pairs of eyes, however, the eye with increased intraocular pressure had a greater number of the defects healed. In the remaining eyes one pair was virtually identical and in the remainder the control eyes had a greater number of healed defects. An average of 81.2 percent of the defects in the control eyes healed as compared to 40 percent in the eyes with elevated pressure.

In the series with 97.5 cm. (H₂O) pressure a mean difference of 12.4 more healed lesions was found in the control eyes. The standard error was 4.2 and the ratio of the standard error to the mean difference was 2.95. With seven degrees of freedom, the probability is 0.022, indicating that the results may be judged significant. The results were not significant in the eyes with pressure increased to 45 or 75 cm. (H₂O).

DISCUSSION

The cause of the delay of healing of small epithelial defects in eyes with markedly increased pressure may be mechanical, biophysical, or metabolic. When the eye is subjected to a greater than normal internal pressure there is some distention of the cornea and sclera. The cornea can stretch in two directions only and becomes thinner in the third dimension. The finding by Gloster, Perkins, and Pommier,¹⁹ and Perkins and Gloster,²⁰ that strips of stretched cornea never return to their original length suggests a structural alteration. It is possible that an alteration in the epithelial layers or the epithelial-stromal junction would impair epithelial cell migration.

It has been suggested by Buschke^{21,22} that the syncytial nature of the corneal epithelium is an important factor in epithelial movements during wound healing, and it is not unlikely that a stretched and thinned cornea might also influence the surface forces acting on the epithelium. Figure 2 shows that the lining cells of the defect in

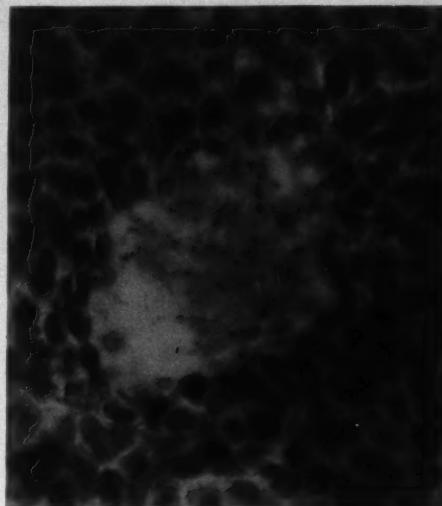


Fig. 2 (Alexander and Newell). Healing epithelial wound in the cornea of rat's eye incubated in vitro at 37°C. for three hours following the injury and with an intraocular pressure of 75 cm. H₂O. (Hematoxylin, $\times 900$.)

each layer are joined by a line which suggests a membranelike state of the defect's border, perhaps mediated by lines of force retracting the defect's lining cells so as to stretch the border outward.

It is possible that the corneal hydration resulting from injured epithelium combined with glaucoma has an inhibitory effect on the healing of epithelial wounds. Figure 3 demonstrates the edema and loosening of the superficial epithelial layers. It should be noted that the epithelium immediately surrounding a healing defect is not involved with edema and loosening. The forces which act in maintaining an intact epithelium for healing are unknown.

The converse of this study was reported by Loewenstein,²³ who observed that hypotony of the eye accelerates healing of epithelial wounds. He offered the hypothesis that the exudate forming in the wound becomes more concentrated as a result of hypotony and that this increases the stimulus for migration. This finding suggests the pos-

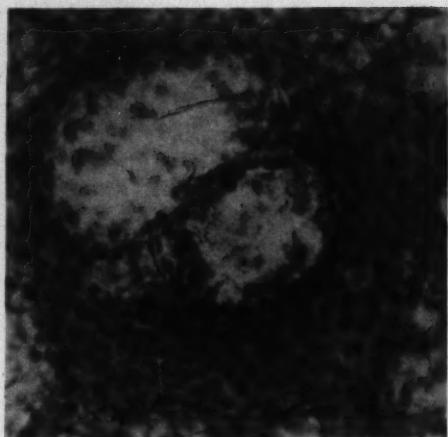
Fig. 3 (Alexander and Newell). Healing corneal epithelium of rat's eye incubated in vitro at 37°C. for three hours following the injury and with an intraocular pressure of 75 cm. H₂O. Edema and loosening of the superficial epithelium with sparing of the area immediately adjacent to the wound are demonstrated.



sibility that the stimulus for migration might be diminished as a result of a diluted exudate, caused by the epithelial edema in a glaucomatous eye.

SUMMARY

The healing of small epithelial defects was studied in explanted rat eyes in oxygenated Sorenson's buffer at 37°C. In eyes with the intraocular pressure increased to 97.5 cm. (H₂O) the rate of healing was decreased



but pressures of 75 cm. and 45 cm. (H₂O) did not adversely affect the rate.

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A NEW TECHNIQUE FOR CORNEAL MUSHROOM GRAFTS* AND ITS INDICATION

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Paufique, Sourdille, and Offret¹ among others have drawn attention to the fact that, in cases of heavily vascularized corneal scars, perforating grafts stand a better chance of remaining clear if preceded by a large lamellar graft. According to Filatov² the improvement in environment brought about by the lamellar graft may be caused by a trophic influence of the graft on the diseased recipient cornea.

The combination of lamellar and perforating grafts may be accomplished in two stages (fig. 1, I and II) or in one stage (fig. 1, III). With either of these methods two separate grafts are used. Franceschetti and Doret³ pointed out that it might be preferable to use a single graft with a large lamellar and a small perforating portion. Because of the suggestive shape, they called this type a "mushroom" graft (fig. 1, IV). Trying to overcome the technical difficulty of cutting this mushroom-shaped graft out of the donor cornea, they devised an apparatus by which this could be done mechanically. While theirs is an ingenious instrument, its manipulation very likely would cause considerable trauma to the tissues of the graft. With the technique to be presented, it is possible to cut a mushroom graft from the donor cornea with a minimum of damage to the tissues. The delicate endothelial layer, in particular, is not disturbed. This is, of course, most desirable.

The technique is illustrated by Figures 2, 3, and 4. The size of both the lamellar and the perforating portion of the graft may be chosen to fit each specific case. I have found that in most cases a diameter of six mm. is most desirable for the perforating portion and a diameter of 11 mm. for the lamellar portion. Recently I have made the perforating portion as large as 7.5 mm. with satisfactory results.

An assistant holds the donor eye in a piece of gauze, exerting a moderate squeezing pressure in order to increase the firmness of the globe. A guarded 11 mm. trephine is then applied and the cornea incised to about half its thickness. A few pricks are made with calipers to outline the area to which the perforating graft should be confined. These marks are 2.5 mm. inside of the incision of the 11 mm. trephine if a six-mm. perforating portion is planned.

Starting with Paufique's angulated knife, later using a large cutting blade, the cornea is then split in the plane of its half-thickness until the area outlined by the calipers is reached. Using a Graefe knife, the anterior chamber is opened, and the whole cornea, together with a small scleral ring, is excised.

The cornea is placed, endothelial side up, on a paraffin block on which a concavity corresponding to the corneal curvature had been made. Again, the limits of the perforating part of the graft are outlined with calipers. A six-mm. trephine is gently applied in that central area, cutting through Descemet's membrane and part of the stroma. The ring, consisting of the deeper layers of the stroma,

* From the McPherson Hospital and the Division of Ophthalmology, Department of Surgery, Duke University School of Medicine. Read at the XVIII International Congress of Ophthalmology, September 8-12, 1958, Brussels, Belgium.

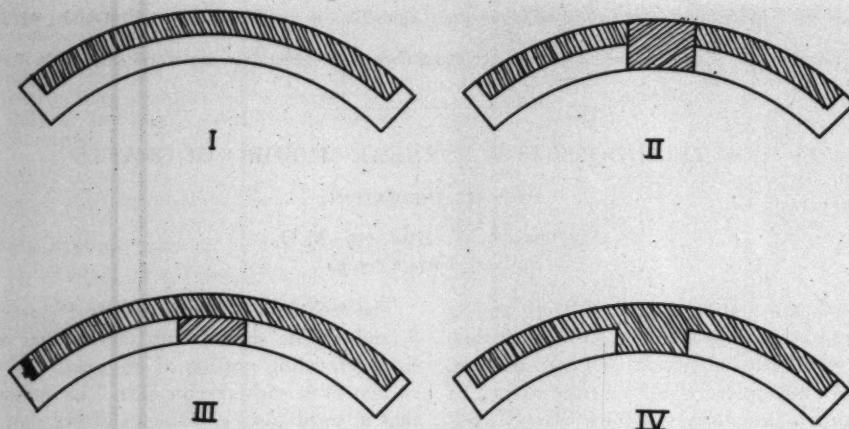


Fig. 1 (Stocker). (I) Lamellar graft. (II) Lamellar graft followed by small perforating graft. (III) Small perforating graft covered by large lamellar graft. (IV) Graft containing a central perforating and a large lamellar portion ("mushroom" graft).

which is to be discarded is completely excised with scissors. Care must be taken that one blade of the scissors always remains between the corneal layers and that the cutting is done exactly along the incision line marked by the six-mm. trephine. In such a manner, a mushroom graft with a six-mm. perforating and an 11-mm. lamellar part is obtained. Two silk sutures are inserted through the lamellar part at opposite sides, and the graft is immersed in serum obtained from the patient to be grafted.

The preparation of the recipient's eye is rather simple. A superficial corneal lamella 11 mm. in diameter is sliced off in the usual manner. A central plug, six mm. in diameter, is next removed by the usual trephination, and the graft is immediately put into place. It is sutured to the recipient's cornea using from 10 to 16 silk sutures. Since only the lamellar part has to be sutured, this is much less difficult than the edge-to-edge suturing of an ordinary perforating graft. Air is usually not injected into the anterior chamber, or

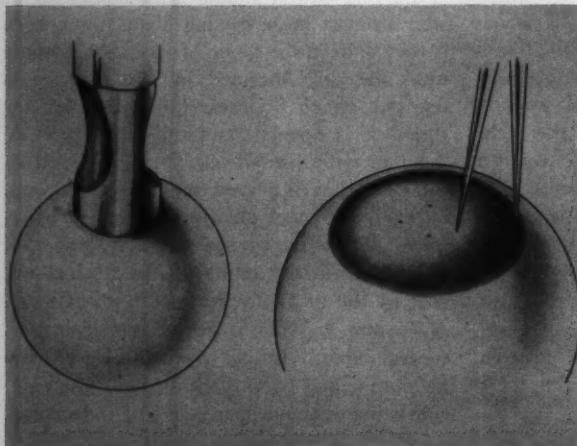
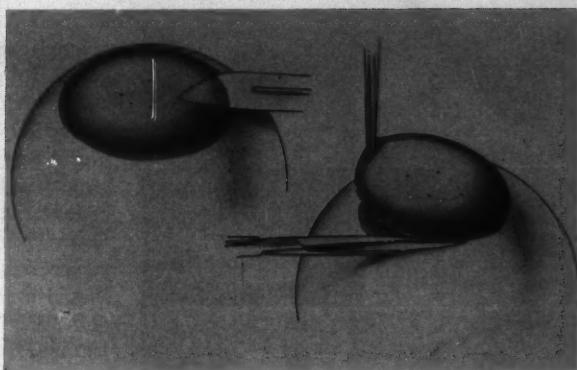


Fig. 2 (Stocker). (Left) The lamellar portion of the graft is outlined with an 11-mm. trephine. (Right) The area of the graft which will be perforating is outlined with calipers.

Fig. 3 (Stocker). (Left) The lamellar portion of the graft is dissected up to the area which will be occupied by the perforating portion. (Right) The total cornea together with a small ring of sclera is excised.



only with great caution, because, if under pressure, it tends to spread between the patient's cornea and the lamellar part of the graft. This should be avoided. Both eyes are closed for three to five days, but the patient is out of bed the day after the operation. No spreading of the wound or iris prolapse is to be feared because of the protecting action of the lamellar ring of the graft. The sutures may be removed on the 10th to 12th postoperative day.

Postoperative complications are few because of the previously mentioned protection of the lamellar part of the graft, the most severe one being secondary glaucoma. This condition may develop, particularly in severely diseased eyes, as it does with any other type of graft and is hardly related to the specific technique described. In the cases of heavily vascularized corneal scars, vascularization may persist or develop postoperatively between the lamellar part of the graft

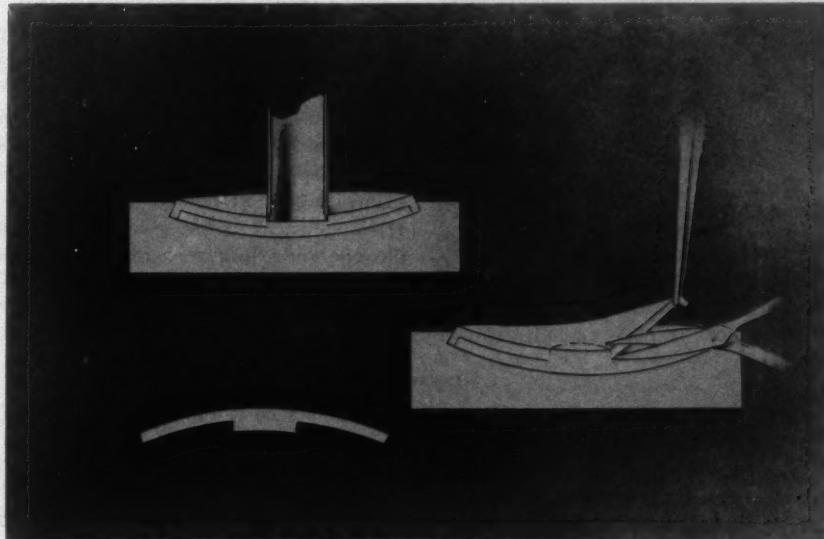


Fig. 4 (Stocker). (Upper) The excised cornea is placed, endothelium up, on a paraffin block and the central perforating part of the graft is outlined. (Middle) The deeper layers of the graft to be discarded are excised. (Lower) Final shape of graft ("mushroom").



Fig. 5 (Stocker). Some of the results. (Left) Before operation. (Right) After mushroom graft.

and the recipient cornea. Usually, however, it stops at the edge of the perforating part.

In addition to dense and severely vascularized corneal scars, I have extended my in-

dication for this procedure to the heavily scarred corneas resulting from previous unsuccessful grafts, to perforating ulcers, and severe bullous keratopathy after cataract extraction. As previously reported⁴ I have, in the past, treated the latter condition with large lamellar grafts. I now feel that I get better results from mushroom grafts, with fewer recurrences of the symptoms and in some cases even visual improvement. If one should use perforating grafts in these cases, quite large grafts would be necessary, as in Fuchs' dystrophy. Since this is a very hazardous procedure in aphakic eyes because of the possibility of large vitreous loss, the technique presented here appears to be safer.

When discussing the results obtained with the present technique of corneal mushroom grafts, one should remember that so far this method has been used only in almost desperate cases. Some of the patients with severe bullous keratopathy had become so desperate because of intractable pain as to demand removal of the offending eye. If in such a case the eye can be made comfortable and some vision, however little, restored, much is accomplished.

Of the 13 cases operated on by the method presented, 12 remained free or almost free of symptoms. In nine cases visual acuity has been somewhat improved. In one case, a severe bullous keratopathy after cataract extraction, visual acuity had improved from recognizing finger movements to 20/40 and had remained so when last seen six months after the operation. Figure 5 illustrates some of the results.

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TONOGRAPHIC CRITERIA IN EARLY GLAUCOMA*

CLINICAL TONOGRAPHY AS AN AID TO THE DIAGNOSIS AND MANAGEMENT OF EARLY GLAUCOMA

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While it is now generally agreed that treatment is most effective in primary glaucoma when it is started very early in the course of the disease, the concept that glaucoma can be diagnosed before measurable structural damage occurs is still too new and controversial to have received wide acceptance. The desirability of techniques which will permit such early diagnosis is obvious. It is our belief, and the belief of others who have worked extensively with tonography, that the clinical applications of this technique offer criteria which make it possible to diagnose primary glaucoma before definite visual-field change can be measured even with the most sensitive techniques.

The material for this study has been gathered in the past several years in the course of a systematic study of very early or low-tension glaucoma. The study was initiated as a result of increasing perplexity about what to do with the rather frequent cases with borderline or normal intraocular pressure which showed other features suggestive of glaucoma. While it was felt initially that some of these cases certainly must represent true low-tension glaucoma, it now appears that virtually all, if not all of them, are simply very early glaucoma or cases which are not glaucoma at all but which have features that for a time suggest this disease. The cases included in the study have all, without exception, had intraocular-pressure readings

below 30 mm. Hg (Schiøtz, 1955 scale) and the majority of them have had tension levels below 25 mm. Hg, at least during the early stages of their study. In addition, cases with obviously advanced glaucomatous field loss have been excluded, regardless of the tension level.

CASE FINDINGS

Cases in the study were found by a case-finding routine which includes routine tension on all individuals 35 years of age and older, careful attention to possibly significant details of the history and especially to a family history of glaucoma, attention to suspicious-looking discs, or in the case of closed-angle glaucoma to very shallow anterior chambers, and, lastly, since it has been available, screening by the multiple pattern tachistoscopic visual field screener has been done on patients in this age group. On the basis of this screening program, plus the additional inevitable referrals of questionable cases, we have found, at the time of this writing, 207 cases which we have felt deserved intensive study and follow-up.

Table 1 lists our present evaluation of these cases, with a listing of the diagnostic clues which led to their inclusion in the study. While some of these cases have been followed for as long as eight years and all at least one year, it is evident, of course, that longer periods of follow-up will change the evaluation of some of these cases and particularly of those in the "probable" groups. Certainly it cannot be emphasized too strongly that definite exclusion of glaucoma is made on any cases deemed worthy of exhaustive study only after repeated completely negative examinations.

* From the Department of Ophthalmology, Bowman Gray School of Medicine, and the North Carolina Baptist Hospital. This study was supported by research grant B-213 from the National Institute of Neurological Diseases and Blindness of the National Institutes of Health, Public Health Service. Presented in part at the third conference on glaucoma of The Josiah Macy, Jr., Foundation, Princeton, New Jersey, January, 1958.

METHOD OF STUDY

The cases which we have subjected to complete study have been handled simply by repeated utilization of the usual diagnostic techniques used in the study of glaucoma, with attempts to use any refinements which will make these techniques more valuable in determining as early as possible and as accurately as possible whether or not the cases were truly glaucomatous and whether or not they deserved therapy.

Tonometry, of course, has been an essential tool, and, as is indicated in Table 1, the Schiøtz tonometer still appears to be by far the most useful case-finding instrument. The effect of scleral rigidity on the apparent tension levels has been appreciated and, while accurate scleral rigidity corrections have not been made, we have attempted to estimate scleral rigidity by taking multiple tension readings with both the 5.5-gm. and 10-gm. weights on the tonometer, pending the availability of the applanation technique in our clinic. On the basis of these readings there have been surprisingly few apparently significant deviations from the average scleral rigidity as determined by Friedenwald.¹

Visual-field study has in general been carried out with the 1/1,000 white isopter, with preliminary training in field technique often done with larger isopters to acquaint the patient with the procedure. For over two years, I have used the black-light technique described by Harrington² almost exclusively, since it has seemed much more accurate and reproducible in my hands than the technique

with standard illumination. It was hoped that the flicker fusion technique might prove an additional valuable tool in this very early group of glaucoma cases but in my hands reliability has been too poor and correspondence between flicker techniques and the usual techniques has been too poor to make me feel that it is of any value.

Gonioscopy has been an essential part of the study, particularly as an aid to classification, where its use in association with provocative testing, particularly in the suspected closed-angle cases, has added greatly to its usefulness in the classification of primary glaucoma.

Provocative testing has proved a tool of major usefulness in this study. For closed-angle glaucoma I have used pupillary dilatation tests, with both dark-room tests and mydriatic tests being used. At this time I have found that the mydriatic test, done with Cyclogyl, is far more likely to give positive results than the dark-room test, and it has been an apparently safe procedure in my hands. For suspected simple glaucoma, the water-drinking provocative test has been used. The great extension of usefulness of provocative testing by the addition of tonography to the more classical performance of the test cannot be emphasized too strongly.

Lastly, tonography has been used extensively and repeatedly on all cases throughout this study, and it is my feeling that criteria which can be obtained with this technique are the most useful diagnostic leads that have been developed in the recent history of the

TABLE 1
MATERIAL FOR GLAUCOMA STUDY
Diagnostic clues leading to glaucoma work-up

Category of Cases	Tension	History	Discs or Visual Field	Tension and History	History plus Discs or Visual Fields	Totals
Probable glaucoma	20	6	2	10	2	40
Glaucoma	73	27	5	24	3	132
Probably not glaucoma	6	13	5	2	3	29
Not glaucoma		5	1			6
TOTALS	99	51	13	36	8	207

study of this disease. Tonographic criteria appear of inestimable value, not only in the diagnosis of simple glaucoma but also in the classification of all primary glaucomas and as an aid to the evaluation of the adequacy of therapy.

The technique of tonography has by now been described too often to need repetition. I do not believe the importance of a recording device, in addition to the electronic tonometer, can be too strongly emphasized if accurate tonographic data are to be obtained. In our clinic we have found the Sanborn recorder quite satisfactory, with only a minor modification of the lead-off circuit of the electronic tonometer necessary to produce a sensitivity high enough to give good tracings on the recorder. It is my understanding that all electronic tonometers sold within the past couple of years have had output sufficiently high to make this minor modification unnecessary. The only additional factor in the technique of tonography which appears to deserve re-emphasizing here is the critical need for meticulously gentle handling of the patient's lids and the tonometer, plus adequate explanation of the technique to the patient to remove his apprehension about it.

CLASSIFICATION OF CASES

In Table 2 is listed the present classification of the 132 definitely glaucomatous cases included in this study.

Cases diagnosed as closed-angle glaucoma have all had either acute congestive episodes or distinctly positive pupillary dilatation provocative tests. In addition, gonioscopy has been done to confirm the closed state of the angle—either partial or complete—during periods of elevated tension.

Cases diagnosed as simple glaucoma have had repeatedly elevated intraocular pressure, repeatedly low facility of aqueous outflow, water-drinking provocative tests which were interpreted as positive because of abnormal aqueous outflow, significant rise in intraocular pressure, and/or a positive P_o/C ratio, plus significant visual field changes, and an

TABLE 2
CLASSIFICATION OF GLAUCOMA CASES

Simple	87
Closed-angle	30
Combined—simple and closed-angle	3
Hypersecretion	4
Equivocal	
Probably simple	3
Probably closed-angle	5
TOTAL	132

open chamber angle. It is evident that all cases do not have all of these criteria for simple glaucoma but a combination of some of these factors was present in all cases diagnosed as simple glaucoma.

Cases called hypersecretion are those with high intraocular pressure, high facility of outflow, and high rate of aqueous flow (flow rate usually or often four cu. mm. per minute or greater, as determined by tonographic measurement).

Combined cases are those which have had acute congestive episodes or strongly positive mydriatic provocative tests in previously established simple glaucoma cases, or cases which have had low facility of outflow (C value) and high or borderline intraocular pressure after successful surgical treatment of acute congestive episodes early in the course of these acute congestive episodes, with no residual anterior peripheral synchia or other obvious structural change in the chamber angle.

It is perhaps most significant that 51 of these cases of simple glaucoma, combined, and hypersecretion glaucoma had no unequivocal reproducible visual field loss at the onset of their study but, by now, only 23 do not show a field defect of diagnostic significance, such as an arcuate scotoma, baring of one of the poles of the blindspot, or a step defect.

TONOGRAPHIC CRITERIA FOR THE DIAGNOSIS OF SIMPLE GLAUCOMA

It is evident that the positive diagnosis of simple glaucoma in many of the cases in this study is made in large part on the basis of tonographic criteria. The validity of such

TABLE 3
TONOGRAPHY IN DIAGNOSIS OF
PROVED SIMPLE GLAUCOMA

C value usually low	68
C value usually normal	2
C value inconsistent	12
C value (Normal—1 eye Low—1 eye)	5
Low C value a major diagnostic lead	68

criteria is attested most convincingly by the later appearance of definite diagnostic visual field changes in the majority of cases in which the diagnosis was initially made in the absence of unequivocal glaucomatous field loss. An analysis of tonographic criteria used in this study should throw light on the interpretation which we have made of these criteria.

For this study, tension levels above 22 mm. Hg (Schiøtz), using the 1955 scales, are regarded as abnormal. The facility of aqueous outflow (C value), like the intraocular pressure, certainly has no absolute normal level, or level below which all cases will undergo pathologic change and above which all cases will remain intact. However, using the 1955 scales established by Friedenwald,³ a C value of 0.19 or 0.20 is usually regarded as the average lower limit of normal, with C values just above or just below this level somewhat equivocal as a result of the inaccuracies

which are inherent in the test.

Tonograms in the 87 cases classified as simple glaucoma in this study are analyzed in Table 3. It is evident that repeated tonograms in this group, in the great majority of cases, gave consistently low C values, and in only two of these cases was the C value usually normal. In most of the cases listed in this table the C value was usually below 0.15. In one of the cases with usually normal C values, diagnostic glaucomatous visual field loss is present and a strongly positive water-drinking provocative test has been obtained. In the other a strongly positive water-drinking test, with a rise in tension to 35 mm. Hg (Schiøtz) in the right eye and 37 mm. Hg in the left, has been obtained. In eight cases the C value has ranged in the somewhat equivocal range between 0.14 and 0.18. In four of these eight cases visual field loss is definite and in all of them the intraocular pressure has intermittently been elevated to levels from 25 to 31 mm. Hg (Schiøtz).

The addition of tonography to the water-drinking provocative tests has greatly extended its value as an aid to the diagnosis of simple glaucoma. To the classic evaluation of this provocative test on the basis of a rise in intraocular pressure, we may add as a positive criterion a fall in the C value to ab-

TABLE 4
WATER-DRINKING PROVOCATIVE IN GLAUCOMA DIAGNOSIS

Rise in Tension (mm. Hg— Schiøtz)	Simple Glaucoma				Water-drinking chief diagnostic or clas- sifying evidence
	Po/c > 100	Po/c > 100—1 eye Po/c < 100—1 eye	Po/c < 100	5	
Less than 6 = 9					
6 plus = 3					
8 plus = 19	28	3	0	Water-drinking confirmatory	
				23	
Other Categories					
Less than 6 = 13	1	1	1	Hypersecretion	
6 plus = 3		2	5	Narrow-angle or closed-angle glaucoma	
8 plus = 2	1	2	5	Open-angle	

normal levels from previously normal or equivocal levels. In addition, Becker⁴ has pointed out the usefulness of the ratio, P_0/C , after water-drinking. It would appear on a statistical basis that where the ratio of the initial tension after water-drinking (P_0) over the facility of aqueous outflow after water-drinking (C) is greater than 100, simple glaucoma is present, and where it is less than 100, simple glaucoma is not present. Empiric evidence would indicate that there is a very high degree of accuracy to this ratio, and if cases in which the ratio is very near 100, that is just above or just below 100, are discarded as equivocal, the degree of accuracy obviously becomes much higher.

In Table 4, an analysis of the results of the water-drinking provocative test in 31 cases of simple glaucoma and 18 suspected cases in other categories is shown. On the basis of a rise in the intraocular pressure, it is apparent that a definitely positive test was found in 19 cases with an equivocal positive in three additional, but the use of the P_0/C ratio gave a positive result in 28 of the 31 cases of simple glaucoma and an equivocal result in the other three—equivocal only in that one eye gave a ratio of less than 100. In the 18 other cases, it will be seen that two cases gave an apparent positive on the basis of tension rise. One of these cases is a proved hypersecretion case and the other is a probable simple glaucoma in which it is felt that data are still in-

TABLE 5
C VALUE AFTER WATER-DRINKING

Simple glaucoma	Normal Low One eye low One eye normal	3 21 7
Other categories	Normal Low One eye low One eye normal	16 0 2

sufficient to make the diagnosis conclusive. There are also two cases in which the P_0/C ratio is greater than 100. Similarly one of these is a hypersecretion case and one is a probable simple glaucoma.

In Table 5, there is an analysis of the C value after the water-drinking provocative test in the same cases indicated in the previous table. Here it is evident that the C value falls to abnormal levels in both eyes in 21 cases and one eye in seven other cases in the proved simple glaucoma cases; whereas, in the other categories it is normal after water-drinking in all but one eye of two cases.

In Table 6, there is an analysis of 24 water-drinking provocative tests which on the basis of tension rise would have been regarded as negative. Among the proved simple glaucomas it is obvious that the C value fell to abnormal levels in all but one case, and that the P_0/C ratio was greater than 100 in both eyes in seven cases and in one eye in the other two cases. On the other hand, in the

TABLE 6
WATER DRINKING PROVOCATIVE WITH LOW TENSION RISE

Simple glaucoma (Tension rise less than 6 = 9)	C value normal	1	$P_0/c > 100$	7
	C value abnormal	8	$P_0/c < 100$	0
	C value normal one eye, low one eye	0	$P_0/c > 100$, one eye $P_0/c < 100$, one eye	2
Other categories (Tension rise less than 6 = 14)	C value normal	13	$P_0/c > 100$	1
	C value abnormal	0	$P_0/c < 100$	9
	C value normal one eye, low one eye	1	$P_0/c > 100$, one eye $P_0/c < 100$, one eye	4
(Tension rise equals 6 = 1)	C value normal one eye, low one eye	1	$P_0/c > 100$, one eye $P_0/c < 100$, one eye	1

TABLE 7
EARLY SIMPLE GLAUCOMA THERAPY

Visual Fields and Facility of Aqueous Outflow		C-Value Normal	C-Value Varies	C-Value Low
Retaining visual fields	17	10	15	
Losing visual fields	4	4	18	
Visual Fields and Intraocular Pressure				
	T Usually Normal	T Varies	T Usually High	
Retaining visual fields	22	11	9	
Losing visual fields	12	8	6	

other categories the C value remained consistently normal and the P_o/C value was less than 100 or equivocal in all but one case, with the case in which it is definitely greater than 100 being an unproved but probable case of simple glaucoma.

While the primary aim of this paper is to deal with diagnostic criteria, a simple and nonstatistical survey of the value of the facility of aqueous outflow as a measure of therapeutic efficacy has been made on 68 of the cases of simple glaucoma which have been followed for two years or longer, with adequate repeated studies. The results of this survey are tabulated in Table 7. In this table normalization of the C value is regarded as maintenance of the C value above 0.16, and normalization of the tension is regarded as maintaining an intraocular pressure of 23 mm. Hg or below. On this basis it is evident that the C value appears to be of little greater value than the tension in so far as the retained visual fields are concerned, but, on the other hand, loss of visual field occurs with much less frequency where the C value is normal than in the presence of normal tension. In a much more extensive study of the prognostic value of tonographic data, Becker⁸ has found that maintaining a C value greater

than 0.15 has led to retention of visual field in better than 80 percent of patients, while maintaining a P_o/C ratio less than 100 has led to retention of visual field in better than 90 percent of his cases followed for over three years. These preliminary studies would certainly appear to indicate that normalization of tonographic values approaches an ideal goal for therapy.

CONCLUSIONS

1. On the basis of our experiences, and experiences of those in other centers where tonography has been extensively used, it appears that tonography is an essential need, which is within the reach of most well-staffed offices where glaucoma will be handled, for the very early diagnosis of simple glaucoma, particularly where measurable visual field loss has not yet occurred.

2. Consistently low C values, or a fall to subnormal C values after the water-drinking provocative test, or a P_o/C ratio definitely greater than 100 after the water-drinking provocative test, appear to constitute valid additional criteria for the diagnosis of early simple glaucoma.

3. Therapeutic control of the C value appears to be the most nearly certain means of preserving visual fields.

SUMMARY

1. The results of tonographic studies in a group of very early glaucoma cases and glaucoma suspects have been tabulated.

2. On the basis of the above tonographic studies, tonographic criteria which appear valid additions to the diagnostic armamentarium for simple glaucoma have been established.

3. The value of therapeutic normalization of the facility of aqueous outflow as a goal in the treatment of primary glaucoma has been indicated.

Bowman Gray School of Medicine.

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STUDIES ON EXPERIMENTAL CORNEAL ALLERGY*

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Since the papers of Wessely (1911) and von Szily (1913, 1914) the concept of anaphylactic interstitial keratitis has been familiar to the ophthalmologist (Woods, 1933). The distinctive feature is a marked clouding of the greater part of the cornea, accompanied by a dense ingrowth of blood vessels from the limbus corneae. The clouding starts at the limbus and progresses toward the center. With the slitlamp the opacity can be located in the corneal stroma. Microscopically it corresponds with an intensive infiltration of inflammatory cells between the lamellae.

This opacity may be band-shaped, the opaque band being concentric with the limbus and consisting of large accumulations of leukocytes. This band-shaped opacity, probably already noted by Wessely, also occurred in experiments on the influence of cortisone in experimental anaphylactic keratitis (Hagedoorn, 1951). (However, in spite of the studies of von Szily, Wessely, and others, the morphology of this experimental anaphylactic keratitis proved to be ill-defined, offering no sufficient base for the cortisone experiments, so that Hagedoorn did not continue them but considered it necessary first to study the phenomenologic part of corneal allergy. We undertook this in the investigation here presented.)

Experiments are generally carried out on rabbits, according to the method of Wessely

and von Szily, using horse serum as foreign protein. Anaphylactic keratitis can be produced by the following two processes among others.

a. Horse serum is injected into a rabbit's cornea, leaving a bleb of fluid, which disappears within a few hours. Like any parenterally introduced antigen, the foreign protein induces antibody formation, so after an induction period of 10 to 14 days in which the cornea remains perfectly clear, antibodies appear in the blood and tissues, reacting in the cornea with the injected antigen—that is, if not all antigen is yet resorbed. A clouding of the cornea starts at the limbus, progresses toward the center, and is followed by a fringe of ingrowing blood vessels. This spontaneous keratitis, appearing 10 to 14 days after (only one) injection of foreign protein, is called Wessely's phenomenon. The phenomenon is of an allergic (anaphylactic) nature and it represents essentially a local analogue of serum sickness.

A modification of Wessely's keratitis was observed by Morawiecki (1956). It is probably related to the phenomena to be described in this paper but it will be discussed more extensively in a following paper. Here we are concerned only with that type of anaphylactic reaction that is produced by a second intra-corneal injection of serum:

b. Not all animals react with Wessely's keratitis. In those corneas where at the time antibodies appear not enough antigen is left to give a macroscopically noticeable reaction,

* From the University Eye Clinic. Director: Prof. Dr. A. Hagedoorn.

von Szily again injected the foreign protein (0.05 cc. undiluted horse serum). Within 24 hours a turbulent keratitis arises, because according to Wessely and von Szily antibodies are amply formed as a result of the first—so called sensitizing—reaction. When the keratitis subsides, it leaves the cornea full of gray patches often persisting for many weeks, and with the remnants of ingrown blood vessels.

We report here two modifications hitherto unknown, as far as we know, to the investigators of experimental corneal allergy.* We use the term ring reaction to denote these modifications.

In his original experiments von Szily standardized this type of anaphylactic reaction—keratitis after reinjection—as follows: (1) Only those animals were used for a second injection whose corneas had not reacted to the first; (2) the amount of injected antigen was standardized at 0.05 cc. undiluted serum.

By deviating in our experiments from both these points the following results were obtained.

EXPERIMENTS

FIRST SERIES[†] (figs. 1 to 9)

In this first series of experiments we deviated from von Szily's second standardization leaving the first one unchanged. By changing the amount of antigen in the reinjection from 0.05 cc. as used by von Szily to the much smaller amount of 0.02 cc., the well-known keratitis fails to develop, but a more refined reaction—the ring reaction—now apparently not masked by the heavy clouding, can be observed with the slitlamp in the corneal stroma.

The chief characteristic of this ring re-

* We wrote this statement in July, 1958. Meanwhile it has been overtaken by the publication of Germuth, et al. (Am. J. Ophth., Nov. 1958).

† In co-operation with the University Laboratory for Histology (Prof. Dr. G. C. Heringa), Amsterdam, Holland.

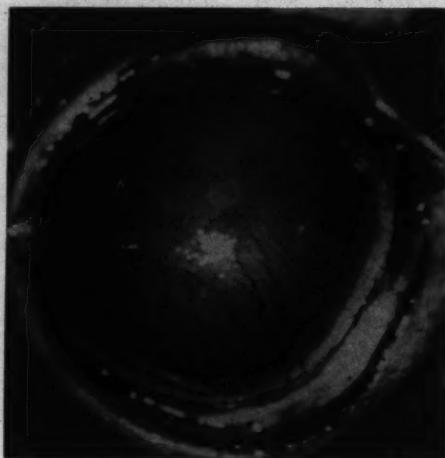


Fig. 1 (Breebaart and James-Witte). Anaphylactic keratitis; heavy clouding and vascularization.

action is that instead of the diffuse inflammation of the greater part of the cornea, reaction now takes place only in strictly circumscribed areas of corneal tissue, visible as thin opaque circles *concentric with the site of injection*. Microscopically these thin and circular areas of reacting tissue correspond with equally limited accumulations of inflammatory cells. Thus, due to the much smaller amount of injected antigen no turbulent keratitis occurs but the cornea remains macroscopically perfectly transparent and only with the aid of the slitlamp can the thin rings of reacting tissue be observed in an otherwise clear cornea, "ring" reaction.

Thus the circumstances for producing a ring reaction are the following:

The cornea of a rabbit is sensitized to horse serum by a first injection of 0.02 cc. serum intracorneally. A fine needle (No. 20) is used for intralamellar injections. If no macroscopic reaction occurs on the 10th to 14th day, three or four weeks after the first injection, a second one is given in the same cornea and again 0.02 cc. sterile, inactivated, undiluted horse serum is introduced, which will lead to a ring reaction. The serum is

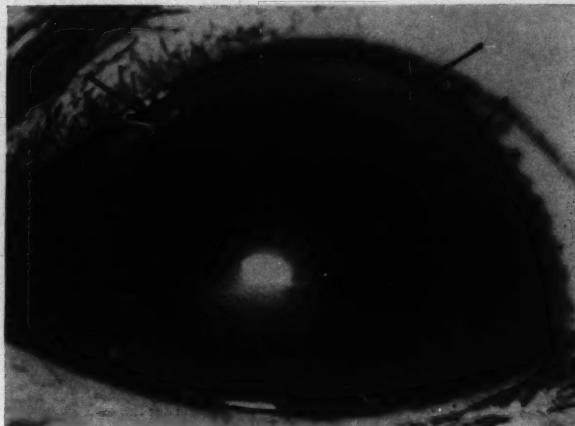


Fig. 2 (Breebaart and James-Witte). Ring reaction: five rings in an otherwise clear cornea.

inactivated by incubating for 30 minutes at 56°C.

The ring reaction phenomenon can be described as follows:

Within a few hours after the reinjection the little bleb of injected fluid disappears, leaving a perfectly clear cornea. During succeeding days the cornea shows no macroscopic sign of reactivity (no clouding, no vascularization). However, by using the slit-lamp, on the first or second day after reinjection, thin opaque stripes of true circular

shape appear: rings or ring fragments, situated concentric to the site of reinjection in an otherwise clear cornea. It is remarkable that from the very beginning of their appearance the rings are located in their ultimate position, distinctly removed from the limbus and, consequently, from any blood vessel. When an eccentric site of injection is chosen it is immediately evident that the rings are not situated parallel to the limbus but that

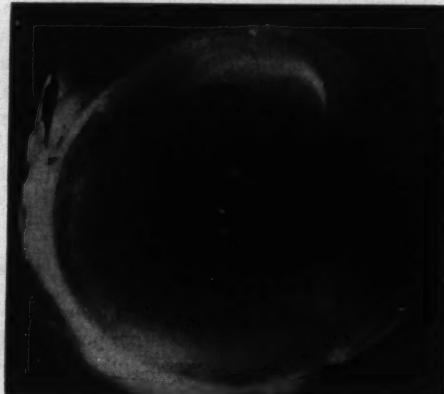


Fig. 3 (Breebaart and James-Witte). Intermediate form; cornea photographed in formalin; peripheral clouding and vascularization; in the transparent center of the cornea are two rings.

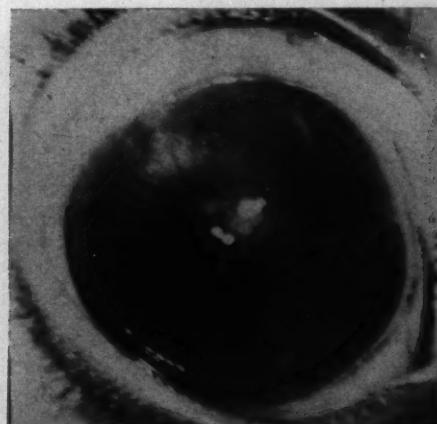


Fig. 4 (Breebaart and James-Witte). Same cornea as Figure 3, photographed before enucleation. Only the peripheral reaction is visible, the rings are of microscopic dimensions.

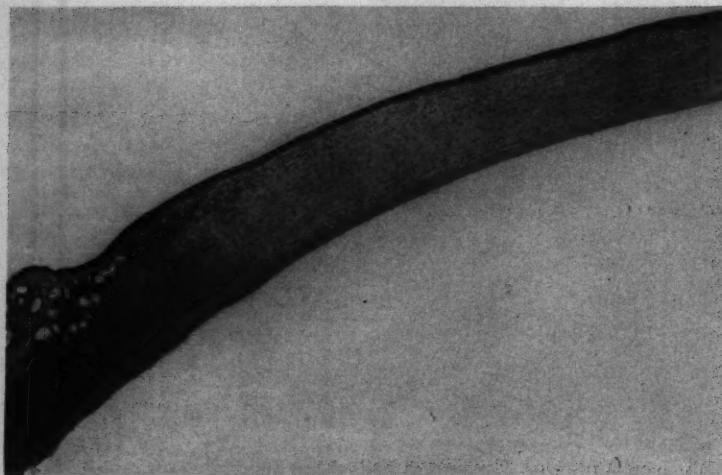


Fig. 5 (Breebaart and James-Witte). Ring reaction, histologic picture: lymphocytic reaction in episcleral tissue, infiltration of lymphocytes and plasma cells from the limbus into the corneal stroma, leading to an accumulation of these cells: a ring.

their location is conditioned merely by the site of injection or, rather, by the circumference of the bleb of injected antigen. The rings remain visible for four to seven days;

afterward they gradually disappear, or often disintegrate into a few white dots. These may persist for many weeks. In no phase of the ring reaction is there any marked ingrowth of blood vessels from the limbus into the cornea.

The use of the slitlamp in observing these phenomena is essential, since the rings are generally not visible to the naked eye or with the binocular loupe. Only in a few cases was it possible to photograph ring reactions in the living eye. It is noteworthy that if the cornea is fixated, after enucleation, with formalin and is observed against a lighted background, the rings become readily visible to the naked eye, probably owing to a swelling of the rings in the fixative.

The ring reaction is a reproducible phenomenon. However, though the ring reaction itself proved to be a constant phenomenon, the number and the relative position of the rings—though always concentric with the site of injection—varied considerably.

Microscopically the ring reaction shows a fairly constant picture: besides a lymphocytic reaction in the episcleral loose connective tissue, an infiltration of lymphocytes and

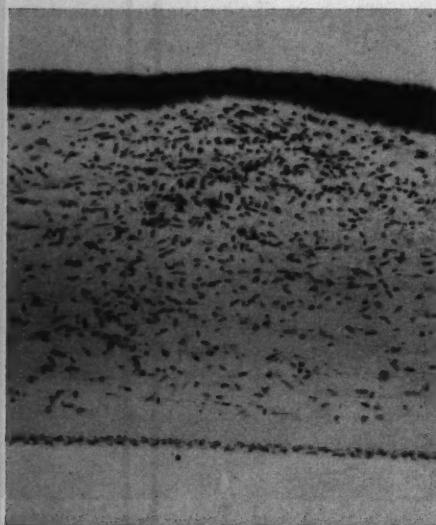


Fig. 6 (Breebaart and James-Witte). Close-up of a ring: accumulation of inflammatory cells; swelling of this part of the corneal stroma pushes away the epithelium above it.



Fig. 7 (Breebaart and James-Witte). Borderline between ring reaction and nonreacting tissue in the corneal stroma: in the right half mostly swollen nuclei of fibroblasts, in the left half of the photograph mostly flat fibroblast nuclei.

plasma cells in the cornea can be seen. The rings correspond in the microscopic sections to accumulations of these infiltrating inflammation cells. Thus there is good correspondence between these sharply circumscribed accumulations in the microscopic sections and the microscopic dimensions of the rings in the living eye as observed with the slitlamp.

Another feature of such an area of reacting tissue is a swelling of the nuclei of the fibroblasts (fixed cornea cells). This phenomenon is also confined only to those parts of the corneal stroma that represent the rings. This swelling of the nuclei, which might indicate a sort of reaction of these cells, is not always present.

It should be noted that, between a pure ring reaction without clouding and vascularization and a fully developed anaphylactic keratitis, intermediate forms with little clouding and ingrowth of a few vessels are possible, due to intermediate amounts of injected antigen between 0.02 cc. and 0.05 cc.

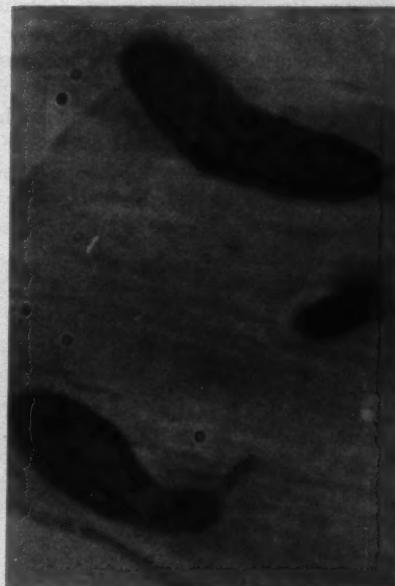


Fig. 8a (Breebaart and James-Witte). Two swollen nuclei of fibroblasts in a ring reaction. ($\times 1,750$)

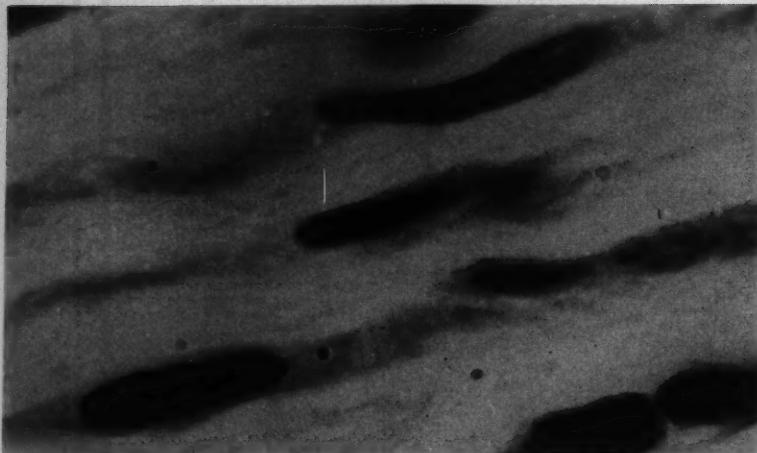


Fig. 8b (Breebaart and James-Witte). Lymphocytes and swollen nuclei of fibroblasts in a ring reaction. ($\times 1,750$.)

SECOND SERIES* (figs. 10 to 17)

This series deals with experiments on corneas which have already reacted anaphylactically and now receive another injection of antigen. By doing so we deviate from the other standardization made by von Szily.

If a fulminating anaphylactic keratitis subsides, it leaves the cornea in the postreactive state characterized by numerous gray patches and remnants of ingrown vessels, with a very slow regression of this state in the weeks following reaction. Histologic examination of such a postreactive state show that the

patches, scattered all over the cornea, are aggregations of lymphocytes. If a moderate keratitis has arisen the postreactive state shows fewer patches and no vessel remnants.

Into such a cornea in the postreactive state 0.02 cc. horse serum again is injected. The result is a ring reaction characterized by a much greater intensity that now makes the reaction perfectly visible to the naked eye. Apparently the injection of a small amount of antigen into a cornea where an anaphylactic keratitis has only just subsided, and the remnants are still present, leads to a very intensive reaction in that corneal tissue, but again the reaction is limited to ring-shaped areas around the site of injection. To dis-

* This section was supported by a grant from the National Health Research Council T. N. O., The Hague, Holland.



Fig. 8c (Breebaart and James-Witte). The flat nuclei of normal, nonreacting fibroblasts (fixed corneal cells). ($\times 1,750$.)

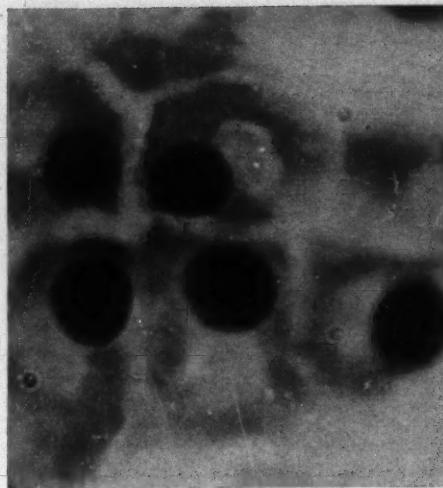


Fig. 9 (Breebaart and James-Witte). Infiltrating plasma cells in an anaphylactically reacting cornea. (Flat section.)

tinguish this type of ring reaction from the original one, the term super-ring reaction is used because of its intensity.

The super-ring reaction starts even before the injected bleb of fluid has spread completely; the first ring(s) become visible on the following day; after three or four days a climax is reached: many super-rings are visible; two or three days later regression sets in. During the reaction clouding of the



Fig. 11 (Breebaart and James-Witte). Super-ring reaction, two super rings.

cornea and further vascularization may occur. Often there is also evidence of an accompanying iritis.

It should be noted that, while in the original ring reaction the first rings to appear are peripheral, the central rings appearing later—in the super-ring reaction the sequence is reversed: the central super rings arise before the distal rings.

Like the original ring reaction the super-ring reaction is reproducible.

Further it should be noted that the intensity of the super-rings is proportionate to the grade of intensity of the postreactive condition: when there is a moderate postreactive

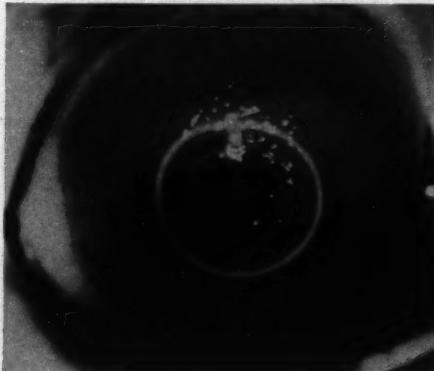


Fig. 10 (Breebaart and James-Witte). Super-ring reaction, one super ring.

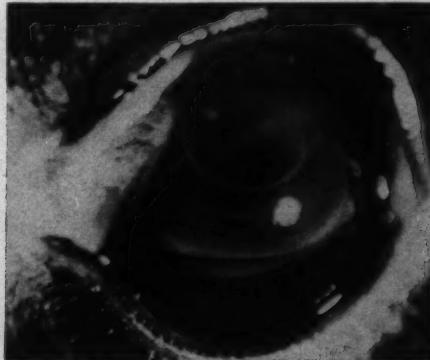


Fig. 12 (Breebaart and James-Witte). Super-ring reaction, many super rings.



Fig. 13 (Breebaart and James-Witte). Same super-ring reaction as in Figure 12, four days later, regression.

tive state intermediate forms between normal and super-rings appear. The intensity of the rings is also more pronounced in areas close to blood vessels than in the more avascular parts of the cornea.

Microscopic study of a super-ring reveals a sharply limited focus of reacting tissue, the reaction this time reaching a climax in mass necrosis of both corneal tissue and accumulated inflammatory cells (polynuclear as well as mononuclear elements).

DISCUSSION

1. For many years the field of experimental corneal allergy was made up of

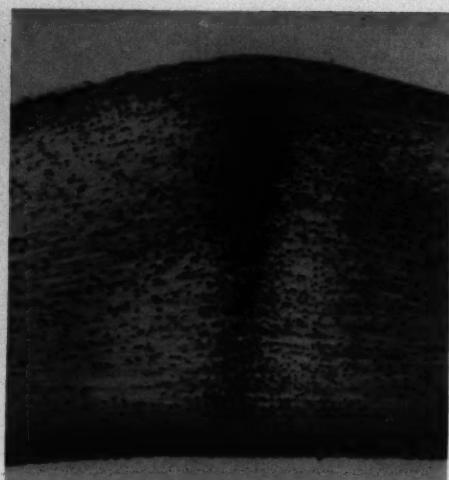


Fig. 15 (Breebaart and James-Witte). Close-up of a super-ring in the microscopic sections; sharply limited focus of necrosis.

Wessely's phenomenon and the various forms of von Szily's anaphylactic keratitis. Recently it has been enlarged with Morawiecki's phenomenon (Morawiecki, 1956). All these phenomena are macroscopically visible reactions, characterized by heavy clouding of the greater part of the cornea and by intensive vascularization. The modifications mentioned, observed by Hagedoorn and Morawiecki respectively, also belong to this group.

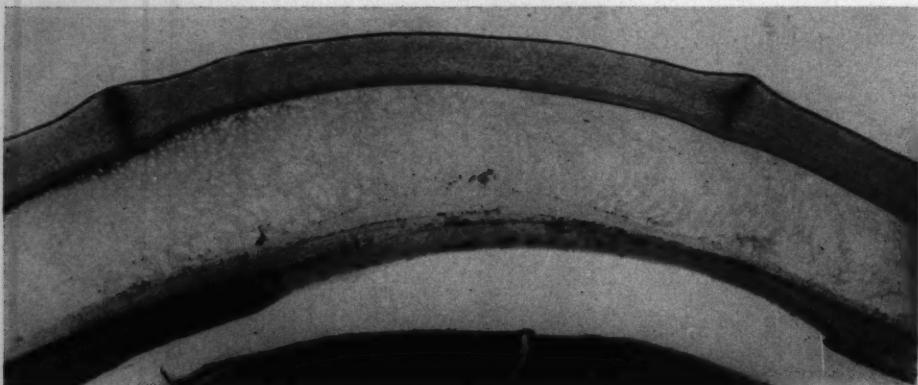


Fig. 14 (Breebaart and James-Witte). Super-ring reaction, histologic picture; section through super-ring of Figure 10. Accompanying iritis.

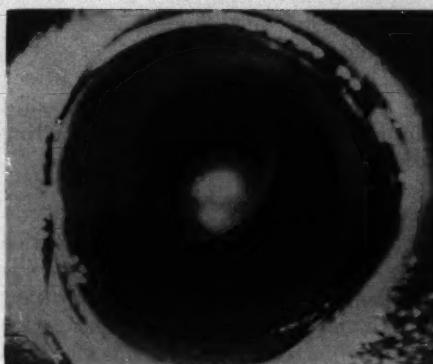


Fig. 16 (Breebaart and James-Witte). Intermediate form: one super-ring, three other rings scarcely visible.

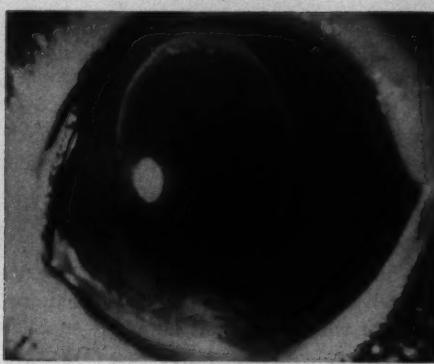


Fig. 17 (Breebaart and James-Witte). Intermediate form: one ring; peripheral part macroscopically visible, the part in the center of the cornea only visible with the slitlamp.

The discovery of two new modes of anaphylactic reaction in the cornea further enlarges this field. However, these reactions differ as a whole from the foregoing group in that a more refined reaction, a microreaction has been produced.

This division into macroreactions and microreactions seems reasonable, for the existence of an experimentally producible and with the slitlamp readily observable microreaction enables us to probe further into the more fundamental questions of allergy. It is the advantage of the cornea above other sorts of tissues that, with the aid of the slitlamp and because of its transparency, minute processes like the ring reaction are observable, whereas the same process of slight accumulation of lymphocytes elsewhere, in the skin or in a mucosa, would be undetectable outwardly even to the most careful observer. In this way these experiments may be placed on a line with the Abell and Schenck experiments on microreactions during anaphylaxis in blood vessels as observed in the transparent ear chamber.

2. One advantage of the ring reaction over the phenomena usually encountered in local anaphylaxis—whether they be a keratitis anaphylactica in the cornea or an Arthus phenomenon in the skin—is the fact of co-existence of strictly limited areas of reacting

tissue side by side with alternating parts of nonreacting tissue. Adequate comparison between reacting and nonreacting tissue under the same conditions—not only in the same animal but also in one and the same organ—is therefore possible. As mentioned above, the comparative histologic examination has already revealed two points of difference between both: the reacting parts alone attract lymphocytes and plasma cells, which consequently accumulate there; and there at times the fixed corneal cells reveal reaction: a swelling of their otherwise flat nuclei. It should be possible to add new points of comparison, for instance by labelling of antibodies or antigen.

3. In 1940 Rich and Follis attacked the problem of the site of sensitivity in the Arthus phenomenon in the rabbit's cornea. They were of the opinion that primarily the site of anaphylactic reaction was not the corneal tissue itself but the limbus cornea with its blood vessels: there the reaction of hypersensitivity takes place at the, according to Rich and Follis, selectively sensitized capillaries (thrombosis, rupture of vessel walls, and hemorrhage), with only secondary effects in the corneal extravascular tissue (edema, polymorphonuclear infiltration) as a consequence of the primary vascular damage of the limbal and ingrown blood vessels.

However, in the ring reaction the interaction of antigen with antibodies takes place in the avascular corneal tissue, and—more important—the site of reaction is not situated parallel to the limbal vessels—which might indicate a relation to the blood vessels—but its position, in the avascular tissue, is independent of the limbus and its blood vessels.

Whether the elements of the corneal tissue themselves participate in the anaphylactic reaction or whether the cornea merely supplies a medium wherein the interaction of antigen with antibodies takes place, cannot be concluded from phenomenology alone. Also, the swelling of the nuclei of fibroblasts—however tempting it is to see this phenomenon as a participation of the corneal cells in the anaphylactic reaction—can also be explained as a secondary effect caused by the infiltration and the accumulation of inflammatory cells.

At last, the problem of the origin of inflammatory cells in the cornea is still not solved. Here, too, one can only state that in the ring reaction inflammatory cells are present, leaving untouched the problem whether they are hematogenous or histogenous in origin.

However—whether the cornea is passively a medium or whether it actively participates in the anaphylactic reaction—interaction of antigen with antibodies outside the vessels or vessel walls in the avascular corneal tissue seems perfectly possible.

From the description of the ring-reaction processes, two questions arise:

Why do only circumscribed parts of the cornea react, and why are these areas condi-

tioned in their location by the site of injection of the antigen?

We hope to discuss this problem in our next paper. Here we have been concerned with the phenomenologic aspects of the ring reactions.

SUMMARY

Two modifications of anaphylactic reaction in the corneal tissue are described. One was observed when the amount of intracorneally injected antigen into a sensitized cornea was reduced from 0.05 cc. undiluted horse serum to 0.02 cc. Clouding and vascularization of the cornea remain absent but with the slit-lamp a reaction of microscopic dimensions can be observed: minute accumulations of lymphocytes and plasma cells arranged in thin circular areas concentric to the site of injection: ring reaction.

Another type of ring reaction, consisting of equal ring-shaped areas of reaction, this time in the form of necrosis, and macroscopically visible, was obtainable when the provoking injection was given into a cornea in which a preceding anaphylactic keratitis had left postreactive patches and blood vessels.

This paper deals only with the phenomenologic aspects of the ring reactions. In a following paper the mechanisms of corneal allergy in general and of the ring reaction in particular will be discussed.

Wilhelmina Gasthuis.

ACKNOWLEDGMENT

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METASTASIS IN RETINOBLASTOMA*

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In a previous report,¹ I presented my observations on retinoblastoma based on 92 patients, 72 of whom showed microscopic evidence of the disease. The present paper will deal chiefly with clinical and pathologic findings in the 20 fatal cases in the previous series. Special emphasis will be placed on metastasis, since its occurrence, however early and whether contiguous or distant, spells sure death in retinoblastoma patients.

Twelve of the 20 patients that succumbed to the disease were admitted to Childrens Hospital in Los Angeles, while the rest were admitted to other hospitals in California. Post-mortem examination was performed in 12 cases, eight being done at Childrens Hospital, two at Kern General Hospital, one at General Hospital of Fresno County, and one at San Diego General Hospital.

CLINICAL DATA

Of the 20 fatal cases, 12 were in males. Sixteen of the patients were of the white race, two were Mexicans, and two were Negroes. The tumor was bilateral in 11 and unilateral in nine. The average age of the patient when first seen was one year and nine months, the youngest patient being three and one-half months and the oldest six years and one month. The average age at the onset of symptoms was one year and four months. The average time of death after the completion of treatment (enucleation) was one year

and four months, the shortest being two and one-half months and the longest, four years.

CONSIDERATIONS ON ANATOMY

Strictly speaking, metastasis may be defined as the appearance of neoplasms in parts of the body remote from the seat of the primary tumor.² In this paper, the term "metastasis" will be treated in a broader sense and will include not only remote or distant metastasis but also contiguous or proximal metastasis.

As shown in Figure 1, there are various routes followed by the retinoblastoma cells from within the affected eyeball to various parts of the body. Like most other tumor

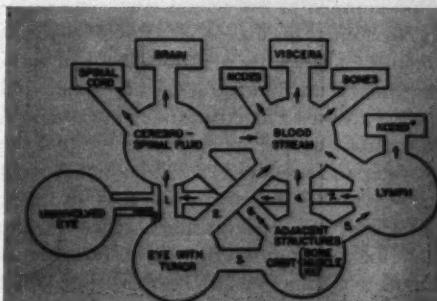


Fig. 1 (Carbajal). Diagram to show routes of metastases: (1) optic nerve substance and subarachnoid space, (2) vortex veins and emissary vessels, (3) contiguity, (4) ophthalmic veins, with their tributaries, many of which consist of newly formed vessels, (5) lymphatic channels (?), (6) contiguity: tumor erodes through orbital roof, (7) Schieck's hypothetical pathway: the lymphatics of the retina run with the central retinal vessels and open into the subarachnoid space.

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Fig. 2 (Carbajal). The subarachnoid space is invaded by tumor cells, while the pial sheath (arrow) is intact.

cells, they are carried away through the blood and the lymph by emboli formation and/or by permeation. Because of the close relationship of the eye and the central nervous system, another fluid transports retinoblastoma cells—the cerebrospinal fluid.

In the orbital cavity, the optic nerve is covered by three sheaths: the pia, the arachnoid, and the dura. In the intracranial cavity the dura is missing and the arachnoid is separated from the nerve by the chiasmatic cistern. Cerebrospinal fluid is normally found in the subarachnoid space, which ends as a blind ampulla at the scleral ring. The endothelial lining of the subarachnoid space is complete⁸; hence, there is no leakage of cerebrospinal fluid. The dura, the arachnoid, and the pia are fused together and firmly attached to the roof of the optic foramen so that the nerve is anchored and cannot be pulled from one cavity to the other. Because of these adhesions, the subarachnoid space in the superior portion of the optic foramen is completely obliterated and cerebrospinal fluid passes forward only through the narrowed passage below. The pial sheath (fig. 2) is so closely applied to the optic nerve proper that the passage of tumor cells from either the subarachnoid space or the nerve substance itself is not likely, except at the points of entry of the central retinal vessels and other smaller vessels supplying the optic nerve proper.

The choroid, which is the vascular coat of the eye, plays an important role in hematogenous metastasis. The tumor cells gain access to this structure either from extension of implantation growths along its surface or around the margin of the optic nerve where the Bruch's membrane terminates.⁴ Flourishing in this rich vascular bed, a tumor embolus may gain entrance into the vortex veins or the emissary vessels* and thence to distant parts of the body through the heart. The viscera, distant bones, and lymph nodes are invaded by this route. It is also possible for tumor cells to enter the central retinal vein[†] and thus enter the general circulation through the heart.

According to Wolff,⁶ Cunningham,⁷ and Morris,⁸ there are no true lymphatics in the human orbit. But lymph is present, and is believed to circulate between the various elements of the retina, and in the perivascular sheath, and, following the veins, is carried through the lamina cribrosa into the lymphatic spaces of the optic nerve. Schieck⁹ states that the lymphatics of the retina run with the central retinal vessels and open into the subarachnoid space. Levensohn,⁶ on the other hand, believes that they pass out through the dura with these vessels.

There are lymphatics in the conjunctiva, and in the lids, in particular. The conjunctival lymphatics are arranged in two plexuses: superficial and deep, draining toward the commissure, where they join the lymphatics of the lid. Those from the outer side drain to the parotid nodes, and those from the inner to the submaxillary lymph glands. The lymphatics of the lids are divided into posttarsal and pretarsal sets, the former draining the conjunctiva and meibomian glands, the latter draining the skin and skin

* In this series, only two cases showed tumor cells in the vortex veins and emissary vessels of the sclera.

† Merriam⁸ reports a case of central vein thrombosis from tumor cells. In this series, emboli formation was seen in the new vessels supplying the tumor tissue in the junction of the chiasma and the opposite nerve.

structures. Both groups drain as follows: those from the outer side run into the preauricular and parotid nodes; those from the inner side into the submaxillary gland (fig. 3).

Other eye structures that have lymphatics are the lacrimal gland and the nasolacrimal duct. Those of the former drain into the conjunctival lymphatics and thence to the preauricular glands, while those of the latter pass to the submaxillary, the retropharyngeal, and deep cervical glands.

There are certain factors to consider in blood-borne metastasis. Once the tumor cells are in the blood stream they may invade any organ, partly according to the law of chance and partly according to certain organ peculiarities, including the size of the tumor emboli. The more blood flowing through an organ, the greater the tendency for tumor cells to gain a foothold. This is one reason offered to explain the frequency of metastatic involvement of the liver. Another is the sluggishness of the blood circulation through the liver sinusoids. Although a tremendous volume of blood flows through the spleen, it is infrequently affected with metastasis. Ewing⁹ explains this on anatomic and mechanical grounds, namely: (1) that there are no lymphatics extending from the abdominal organs into the spleen; (2) that the circulation of the spleen is very active. Warren and Davis¹⁰ also believe that the mobility of the spleen has an influence in limiting metastases. Coman's work¹¹ suggests that emboli are trapped and their growth blocked by the thick-walled penicillar arteries travelling through the centers of the splenic follicles.

ROUTES OF METASTASES

In this series, there were five routes or pathways of metastases: (1) cerebrospinal fluid, (2) blood stream, (3) orbit-to-orbit, (4) contiguity, and (5) lymph. Table 1 reveals that the first route was the most common. In the majority of cases, there was a combination of two or more types, the most common combination being that of the first

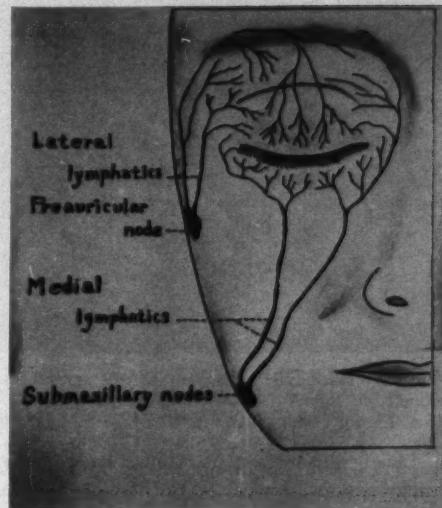


Fig. 3 (Carbajal). Diagram showing lymphatic drainage of the lids.

(cerebrospinal fluid) and second (blood stream).

The cerebrospinal fluid was the principal medium by which the tumor cells were carried into the brain and spinal cord, although, in at least two cases, the tumor cells were not demonstrable in the optic nerve substance or in the optic subarachnoid space. In the latter situation, the tumor eroded through the orbital bones to gain entrance into the cerebral subarachnoid space. In one of these, the tumor destroyed the ethmoids and nasal bones, possibly working through the cribriform plate (fig. 4). We may classify this route as that of contiguity, combined with the cerebrospinal route.

In all the cases where there was visceral

TABLE 1
METASTASES: ROUTES AND INCIDENCE
(12 autopsies)

Routes of Metastases	No. of Cases	Percentage
Cerebrospinal fluid	9	75
Blood stream	7	58
Orbit to orbit	6	50
Contiguity	2	16
Lymph	2	16



Fig. 4 (Carbajal). Invasion of the structures around the right orbit, including the nose. Case 5. (See Figure 14-e.)



Fig. 5 (Carbajal). Bilateral retinoblastoma, the left being far more advanced than the right. Tumor recurred in left orbit five months after enucleation, and patient died 14 months later. Case 7. (See Figure 15-a.)

involvement, metastasis must have been hematogenous. And so were the cases where there was involvement of the distant bones and nodes. In one baffling case, however (fig. 5), there were tumor cells in the mesenteric nodes and long bones, but none in the visceral organs themselves. This may indicate hematogenous combined with lymphogenous routes.

Except in one, all of the seven patients (table 2) with choroidal involvement had evidence of distant metastases. In five of

TABLE 2
RELATIONSHIP OF CHOROIDAL INVOLVEMENT, ORBITAL RECURRENT AND
DISTANT METASTASES
(12 autopsies)

Case No.	Orbital Recurrence	Viscera	Distant Metastases		
			Bones	Nodes	
A. With choroidal involvement					
1	Present	Liver, Pancreas, Bile duct, Kidney	Vertebrae, Ribs, Ilium	None	
2*		Liver	None	None	
3	Absent	None	None	Peritonsillar	
9†	Present	None	None	None	
10	Present	Liver	None	None	
11	Present	Liver, Pleura	Ribs	Mesenteric, Iliac, Inguinal	
12	Present	None	Vertebrae	None	
B. Without choroidal involvement					
4	Present	Kidney, Liver, Pancreas, Large Ves.	Sternum, Ribs	Portal, Periaortic, Lumbar, Suprascapular, Posterior cervical	
5	Present	Liver, Pancreas, Kidney, Spleen	Vertebrae	Parotid	
6	Absent	None	None	None	
7	Present	None	Radius, Ulna	Mesenteric	
8‡	Present	None	None	None	

* Patient did not undergo enucleation.

† Patient died suddenly from compression of vital centers by huge fungating mass juxtaorbital to pons. Not sufficient time for distant metastases to occur.

‡ Patient died from purulent meningitis before distant metastases could take place.

these, the sclera was infiltrated with tumor cells (fig. 6). In three of the five cases with no choroidal involvement, there was no doubt that the tumor cells were carried through the blood circulation, since distant metastasis was preceded by the recurrence of a highly vascular tumor in the orbit.

The purely lymphogenous route is difficult to demonstrate in this series, as the presence of lymphatics in the orbit is denied by various anatomists. However, in one case, the first site of metastasis was the preauricular node, which later enlarged to golf-ball size.* In another case,† the parotid nodes were affected two to three months after recurrence of tumor in the orbit.

As indicated in Figure 1, tumor cells may follow the subarachnoid space from one orbit to the other. Here, if given enough time to multiply, they form a retrobulbar tumor mass of considerable size. In one patient, full-blown papilledema was observed in the originally uninvolved eyeball due to compression of the central retinal vein by the fast-growing retrobulbar tumor.

The tumor cells after escaping into the subarachnoid space usually travel faster than the tumor cells in the nerve substance itself.

* This case was that of a 21-month-old Caucasian girl who exhibited on admission a proptosed right eyeball, with an opaque cornea and an enlarged preauricular node. The right eye had been struck with a blunt object a year prior to this and had swollen up on several occasions. Admission was advised because of intraorbital calcification on both sides. Funduscopic examination in both eyes was not satisfactory on account of the haziness of the cornea and media. The right eyeball was enucleated and the right preauricular node was excised. During surgery it was noticed that the tumor had perforated through the eyeball temporally. Microscopic examination revealed marked involvement of the choroid, ciliary body, and iris, including portions of the cornea and sclera.

† This was a Caucasian baby boy who showed a pupillary reflex in the right eye at three months of age. Enucleation was performed at the age of 11 months. Thirteen months after this, the parents noted bulging in the outer corner of the right eye, the prosthesis being pushed medially. Biopsy of this mass revealed recurrence of tumor. Despite deep X-ray therapy, the tumor mass grew rapidly, destroying the right orbit (figs. 4 and 14-e).



Fig. 6 (Carbajal). Section of the sclera showing infiltration by tumor cells. The disposition of the scleral fibers is distorted by tumor cells.

When they reach the intracranial portion, they take at least one of two routes: namely, to the other orbit and/or into the chiasmatic cistern, where they grow exuberantly and even invade the chiasma itself. From here, as will be elucidated later, they may proceed to the pituitary gland capsule or continue to bathe the whole ventricular cerebrospinal system of the brain, down to the spinal cord. The meninges, which envelop the brain substance, bear the brunt of the intracranial metastasis; and later even the brain cortex is invaded by tumor cells. However, before this occurs, a huge tumor mass may have grown in the meninges (in the pons area in one case), producing mechanical compression of vital centers.

Metastasis by contiguity has accounted for intracranial involvement in two cases. The first step in this route is orbital recurrence. Generally speaking, recurrence is a clinical term used to describe the reappearance of a tumor once it has been apparently removed. Recurrence indicates that some of the original tumor cells have survived and have eventually multiplied to such an extent that the tumor is again clinically obvious. In this series, of the 20 cases succumbing to retinoblastoma, 13 had orbital recurrence, six had none, and one was admitted too late for enucleation.

TABLE 3
RELATIONSHIP BETWEEN ORBITAL RECURRENCE
AND METASTASIS
(Based on 20 fatalities)

Orbital Recurrence	Metastases (percent)	
	Extracranial (Viscera, Nodes, Bones)	Intracranial Brain, Meninges
Present	70	30
Absent	25	75

In the majority of cases, orbital recurrence was ushered in by the appearance of a raw-looking beefy mass, which pried the lids open. In three children, trouble was suspected by the parents on account of the displacement of the conformer. The recurrent mass bled profusely in three other cases, necessitating immediate admission.

The recurrence of tumor was, on the average, noted five and a half months after enucleation,* ranging from three months to eight months. Death occurred in these patients about nine and a half months after enucleation or four months after the recurrence of tumor in the orbit was clinically obvious.

Table 3 indicates that cases with orbital recurrence are more liable to be afflicted with distant metastases than those without. On the other hand, the latter develop intracranial metastases more readily than the former.

In Table 4, various clinical factors are studied as to their influence on orbital recurrence. Because of the limited number of cases in this series, the findings unfortunately are not statistically significant. However, it is interesting that those cases presenting orbital recurrence had longer delay in enucleation than those without.

Certain pathologic findings are tabulated in Table 5. Except for that of extrabulbar mass (fig. 7), all the other findings—involve-

* Doubtless the recurrence must have appeared soon after enucleation, but was not clinically evident.

TABLE 4
CLINICAL FACTORS INFLUENCING ORBITAL RECURRENCE IN 20 FATAL RETINOBLASTOMA CASES

Factors	Orbital Recurrence	
	Present	Absent
Age at onset of symptoms (mo.)	13	25
Delay in enucleation (mo.)	10	6½
Laterality (cases)		
Bilateral	7	4
Unilateral	6	1
Sex (cases)		
Male	9	1
Female	4	4

TABLE 5
PATHOLOGIC FINDINGS* AND INCIDENCE OF
ORBITAL RECURRENCE
(Based on 20 fatal cases)

Findings	Number of Cases†	
	With Orbital Recurrence	Without Orb. Rec.
Scleral invasion	4 (30%)	1 (17%)
Choroidal involvement	8 (61%)	2 (34%)
Nerve invasion	10 (77%)	4 (72%)
Anterior segment involvement	3 (23%)	1 (17%)
Extrabulbar mass	2 (15%)	0

* Microscopic examination of enucleated eyeball. Later, autopsy examination revealed nerve invasion in two where the report on the enucleated eyeball had been reported negative or doubtful.

† Thirteen cases showed orbital recurrence, six had none, and one did not undergo enucleation.

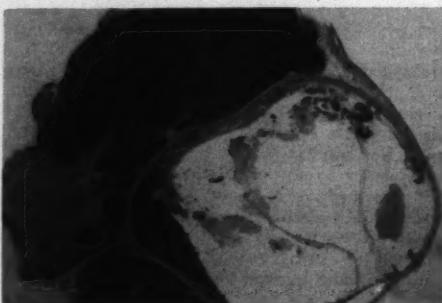


Fig. 7 (Carabajal). Section of an eyeball with extrabulbar tumor. Case 9. (See Figure 15-c.)

ment of the sclera, choroid, nerve, and anterior segment (fig. 8)—were demonstrable in both those with orbital recurrence and those without. However, the incidence of

TABLE 6

SURGICAL TECHNIQUE AND ORBITAL RECURRENCE

Surgical Factors	Orbital Recurrence		
	Present	Absent	Total
Sclera perforated at surgery*	2	0	2
Length of optic nerve excised:			
5 mm. or less	4	0	4
7 mm. or more	0	2	2

* Sclera had been thinned considerably by expanding new growth.

scleral and choroidal involvement was higher in those cases with orbital recurrence than in those without. Nerve invasion, which was about equal on both sides, was the most important consideration in this study; for it was the main factor in intracranial metastasis and possibly in orbital recurrences. As mentioned previously orbital recurrence was almost tantamount to distant metastasis. Of course, the presence of extrabulbar mass in the eyeball before enucleation always meant orbital recurrence.

Table 6 was prepared to show that surgical technique definitely influenced orbital recurrence. It is conceivable that metastasis may occur in the course of surgery (enucleation) by spillage from the subarachnoid space of the optic nerve stump or perhaps

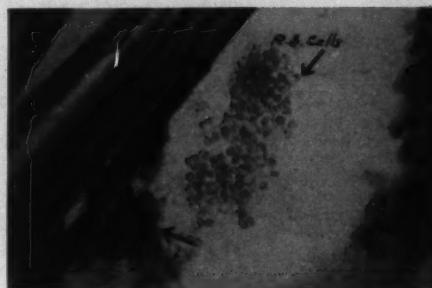


Fig. 8 (Carbajal). Section of the anterior segment showing tumor cells and red blood cells in the anterior chamber. The keratic precipitate (arrow) consists of clumped tumor cells.

from the retrobulbar blood and lymph (?) channels.

CLASSIFICATION OF METASTASES

In a previous paper,¹ I presented a preliminary classification of metastases in retinoblastoma. For the sake of conciseness and clarity, I have further revised it as shown in Table 7. The main basis for this classification is whether or not the brain is involved. Hence, if the brain is affected with tumor cells, the metastasis is branded as *intracranial*; if the brain is not affected, *extracranial*. Several facts are evident in Table 7: (a) metastasis can be confined to the brain

TABLE 7
GENERAL CLASSIFICATION OF METASTASES IN 12 AUTOPSY CASES OF RETINOBLASTOMA

	Classification	Incidence	Case No.*
A. Intracranial.....		9 (75%)	
1. Without visceral involvement.....		6	
a. Intracranial only.....	3		6, 8, 9
b. Intracranial and spinal cord.....	2		
(1) Skull only.....	1		3
(2) Skull and distant bones.....	1		12
c. Intracranial, skull, distant bones, nodes.....	1		7
2. With visceral involvement.....	3		
a. Skull and distant bones.....	1		1
b. Skull, distant bones, nodes.....	1		11
c. Skull, distant bones, nodes, and spinal cord.....	1		4
B. Extracranial (Brain not affected).....		3 (25%)	
1. Viscera and skull.....	2		10, 2
2. Viscera, skull, distant bones, and nodes.....	1		5

* See Figures 14 and 15.

† This case might well have been on the way to visceral involvement, as the mesenteric lymph nodes, radius, and ulna were invaded by tumor cells.

‡ On the way to brain invasion through eroded orbital bones.

TABLE 8
SITES OF METASTASES OF RETINOBLASTOMA
IN 12 AUTOPSISES

Intracranial structures.....	9
Optic nerve (intracranial portion).....	9
Optic nerve proper.....	4
Subarachnoid space only.....	5
Chiasm.....	6
Chiasm proper.....	4
Subarachnoid space.....	2
Arachnoid.....	9
Dura.....	6
Pia.....	4
Subarachnoid space.....	9
Ventricles.....	4
All ventricles.....	1
4th ventricles.....	2
3rd ventricles.....	1
Lateral.....	1
Cerebral cortex.....	4
Cerebellum.....	4
Pons.....	2
Pituitary gland capsule.....	3
Lateral sinus.....	1
Isolated masses:	
On sella turcica.....	1
Juxtorstral to pons.....	1
Cranial nerves (not examined).....	
Spinal cord.....	
Subarachnoid space.....	3
Dura.....	2
Cord itself.....	0
Sheaths of spinal nerve roots.....	1
Skull bones.....	
Parietal (diffuse in 1).....	2
Frontal.....	1
Occipital.....	1
Floor of anterior fossa.....	2
Floor of middle fossa.....	1
Unspecified.....	2
Bones around orbit.....	6
All walls.....	1
Lateral wall.....	1
All walls except floor.....	1
Roof only.....	1
Superior orbital fissure (left).....	1
Facial bones.....	
Maxilla.....	2
Mandible.....	1
Sinuses.....	
Maxillary.....	2
Ethmoid.....	2
Sphenoid.....	1
Invasion of nose.....	
Invasion of nasopharynx.....	1
Distant bones.....	6
Ribs.....	4
Vertebrae.....	3
Sternum.....	1
Ilium.....	1
Radius.....	1
Ulna.....	1
Humerus.....	1
Lymph nodes.....	
Mesenteric.....	2
Iliac.....	1
Inguinal.....	1
Lumbar.....	1
Supraclavicular.....	1

TABLE 8 (Continued)

Periaortic.....	1
Portal.....	1
Peritonsillar.....	1
Submaxillary.....	1
Parotid.....	1
Posterior cervical.....	1
Adjacent to pancreas.....	1
Visceral organs.....	6
Liver.....	6
Kidney.....	3
Pancreas.....	2
Spleen.....	1
Lung (subpleural space).....	1
Common bile duct.....	1
Great vessels (abdominal aorta).....	1
Muscles (not specified).....	2

only; (b) metastasis to distant organs only is a rarity, for this does not occur without involvement of at least the calvaria and, in the majority of cases, the brain itself; (c) when the distant nodes are affected, the long bones, too, are involved; (d) spinal cord involvement is associated with invasion of the brain—the meninges of the brain, at least.

SITES OF METASTASES

In Table 8, the sites of metastases in 12 autopsy cases as proved by gross and microscopic examination are tabulated.

INTRACRANIAL STRUCTURES

The meninges of the brain were the most commonly involved structures, the arachnoid and its corresponding space (fig. 9) being hit the hardest. This supports the fact that retinoblastoma cells not only travel through the cerebrospinal fluid, but also thrive in it. The dura appeared intact unless compressed by a contiguous tumor, eroding through the orbital or cranial wall. When this happened, it was invaded by tumor cells from without. The pia tended to prevent involvement of the cortex of the brain, but sometimes failed.

Of the six cases where the skull was affected, the inner surface of the calvaria was eroded in four. In all of these four cases, the dura was involved. In one (Case 2, fig. 14-b) of the two cases where the dura was spared,



Fig. 9 (Carbajal). Section of the inferior surface of cerebrum showing generalized involvement of the meninges. Case 3. (See Figure 14-c.)

the calvarium showed three dark purple masses which were not contiguous with an eroding tumor, although the left optic nerve was enlarged up to the optic foramen. The masses projected from the inner table but the dura was not affected. This indicates that the periosteum is efficient in confining metastatic areas in the calvarium within the bone. Based on the aforementioned findings, it is evident that dural metastases represent a direct spread from neoplastic areas in the calvaria or from a contiguous orbital tumor, while subarachnoid metastases, a continued spread from the involved optic nerve and chiasm.

In one patient, there was clinical evidence of nose involvement (fig. 4). Unfortunately, there was no microscopic description of the cribriform plate. It was possible that in this case the intracranial extension was brought about by invasion of the nose by the expanding retinoblastoma tumor and subsequent passage through the cribriform plate.

The involvement of the brain substance, which occurred in four patients, may be the result of a direct spread from the subarachnoid space, usually pushing along vascular channels, a direct invasion from the chiasm, or may result from continued inward erosion by tumor through the dura, the arachnoid, and pia until the cortex is reached.

The pituitary gland (fig. 10) was invaded in three cases, only the capsule being involved. This is easily comprehended in view

of the proximity of this gland to the optic chiasm (also involved in these three cases) and also because the leptomeningeal reflections form the capsule.

OPTIC NERVE, CHIASM, VENTRICLES

All of the 12 autopsy cases showed optic nerve involvement. In four of these, the nerve proper was affected throughout its length as far as the chiasm. In six cases, the retinoblastoma cells traveled through the subarachnoid space of the optic nerve (fig. 11) and invaded the opposite nerve through the chiasm. The opposite eyeball was never invaded internally by this route, although in two cases the tumor cells proliferated very much in the ampullar ending of the subarachnoid space, ballooning it and actually forming a retrobulbar tumor mass that produced papilledema in one. This bears out the fact that the sclera is an efficient protective coat of the eye as well as the fact that tumor cells are carried in the vein and not in the artery. Otherwise, the opposite eyeball would have shown actual metastatic lesions in addition to papilledema.

As stated in the beginning of this paper, the retinoblastoma cells are carried in the lymph circulating between the various elements of the retina, and finally reach the subarachnoid space around the nerve. This space may be invaded by direct spread from the optic nervehead (fig. 12) or from the region where the central retinal vessels gain entrance to the nerve. However, in none of these autopsy cases was there demonstration

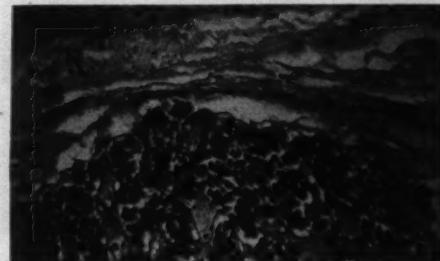


Fig. 10 (Carbajal). Section of the pituitary gland showing invasion of the capsule (arrow). Case 3.



Fig. 11 (Carbajal). Longitudinal section (a) and cross section (b) of the opposite optic nerve illustrating orbit-to-orbit metastasis. Take note of the limitation of the tumor cells within the subarachnoid space and the infiltration of the arachnoid sheath in places. Case 3.

of tumor cells entering only the vaginal sheath through the disc. It might be possible for the nerve to be invaded indirectly; that is, along an emissary vessel or ciliary nerve. However, when this happens, there is already an extrabulbar mass. This was apparent in two cases.

Most commonly the tumor spreads along the nerve bundles in the nerve proper (fig. 13-a) and the nerve fibers become atrophic from pressure. The trabecular fibers are also compressed and separate the neoplastic cells into groups. In one case, the compression of

the nerve fibers was brought about not only by the tumor cell groups but also by the newly formed vessels (fig. 13-b).

It is interesting to note that the spread of the neoplasm to the intracranial structures is hastened by invasion of the optic subarachnoid space by tumor cells. Here they travel and may re-enter the nerve. In only one case* (fig. 14-b) was there spillage of these tumor cells into the orbit directly from the nerve, which had become enormously enlarged. In this case, the posterior portion of the orbit was filled with dense cellular tissue. Microscopic examination revealed a tendency to rosette-formation.

Being just a potential space, the subdural space is not invaded by tumor cells as much as the subarachnoid. It was involved in only two cases where there was extrabulbar extension of the tumor.

The tumor extended to the intracranial

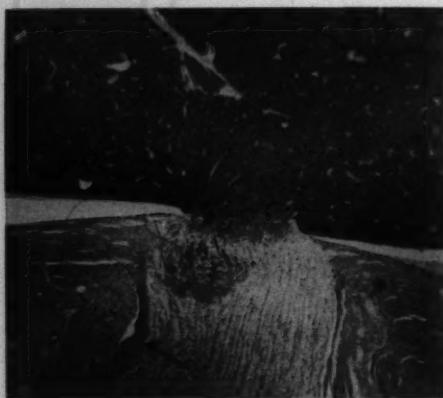


Fig. 12 (Carbajal). Retinoblastoma tumor arising from the nervehead area. The optic nerve is invaded beyond the lamina cribrosa. The subarachnoid space (arrow) is teeming with tumor cells.

* This 25-month-old Caucasian boy had evidence of tumor in the left eye at birth. The left eye appeared weak and without normal movements. At 10 months of age, the eyeball was definitely proptosed. Approximately three months prior to admission the child was irritable and anorexic. The abdomen was huge and tender. The child being a poor surgical risk, enucleation was not done—just supportive treatment. Autopsy examination revealed massive hemorrhage in the peritoneal cavity and hematoma of both testicles. There was no jaundice, although the liver weighed over 2,000 gm.

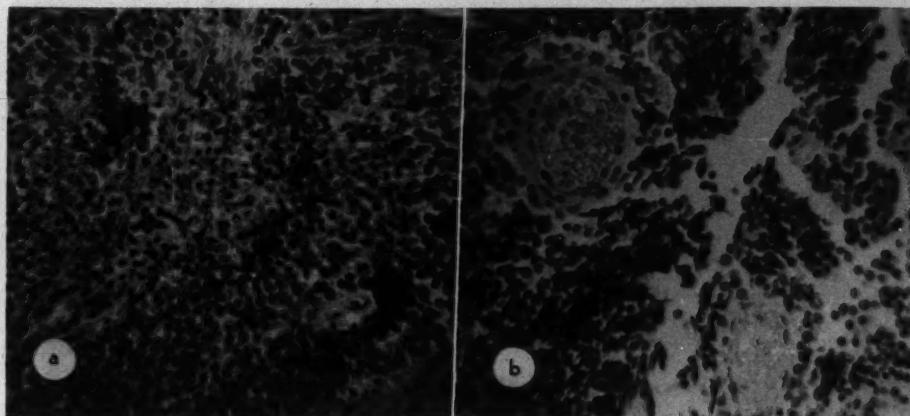


Fig. 13 (Carbajal). (a) Longitudinal section of cut end of the nerve, showing diffuse involvement with tumor cells. (b) Cross section of nerve behind the lamina cribrosa, showing new vessel formation. Case 3.

portion of the optic nerve in nine of the autopsy cases, four showing involvement of the nerve proper and five showing invasion of the subarachnoid space only (figs. 14-c, f, and 15-b, c, d). The optic nerve in the surgically excised eyeball showed infiltration beyond the lamina cribrosa in seven cases; at the site of operative severance of the nerve in three; throughout the length of the excised nerve in two. Except in one case, there was generalized involvement of the leptomeninges. The chiasm (fig. 16) was destroyed in four cases and was superficially involved in two others. In three, the pituitary gland capsule was invaded by tumor cells, and the sella turcica was eroded in one.

Because of the proximity of the third ventricle to the chiasm, the former is readily invaded, once the latter has become involved. It is unfortunate that not all of the cases with third ventricle involvement had been microscopically examined. However, in one patient with chiasmatic invasion, the ependyma of the ventricles were almost completely replaced by tumor cells. It is possible for blood-borne tumor cells to enter the ventricular system through the choroid plexus, but this was not explored in this series.

The lateral sinus (left side) was occluded by tumor emboli in one patient who showed

erosion of the floor of the left anterior fossa (fig. 17). There was early involvement of the capsule of the pituitary gland and the meninges of the spinal cord but not the brain itself. The dura close to the periosteum showed some early involvement. The visceral organs (liver, pancreas, kidney) were invaded by tumor cells. The gall bladder was greatly distended from blockage of the intrapancreatic portion of the common bile duct.

SPINAL CORD

In three cases, the spinal cord showed the earmarks of metastasis, but limited to the subarachnoid space only in two (fig. 18) and the dura in one,* the spinal cord proper being spared in the first two. The sheaths of the spinal nerves were sprinkled with tumor cells in one case,[†] and in all three cases, there

* Specimen was examined only grossly; slides were misplaced and microscopic examination could not be done on the spinal cord section. It is possible that the spinal subarachnoid space was teeming with retinoblastoma cells as the brain meninges were studded with these.

† In this case there was involvement of the body of a vertebra. It is interesting to note that in this lone case, metastasis was limited to the intracranial structures and spinal cord only. On the other hand, two other patients with vertebral involvement showed diffused involvement of the viscera.

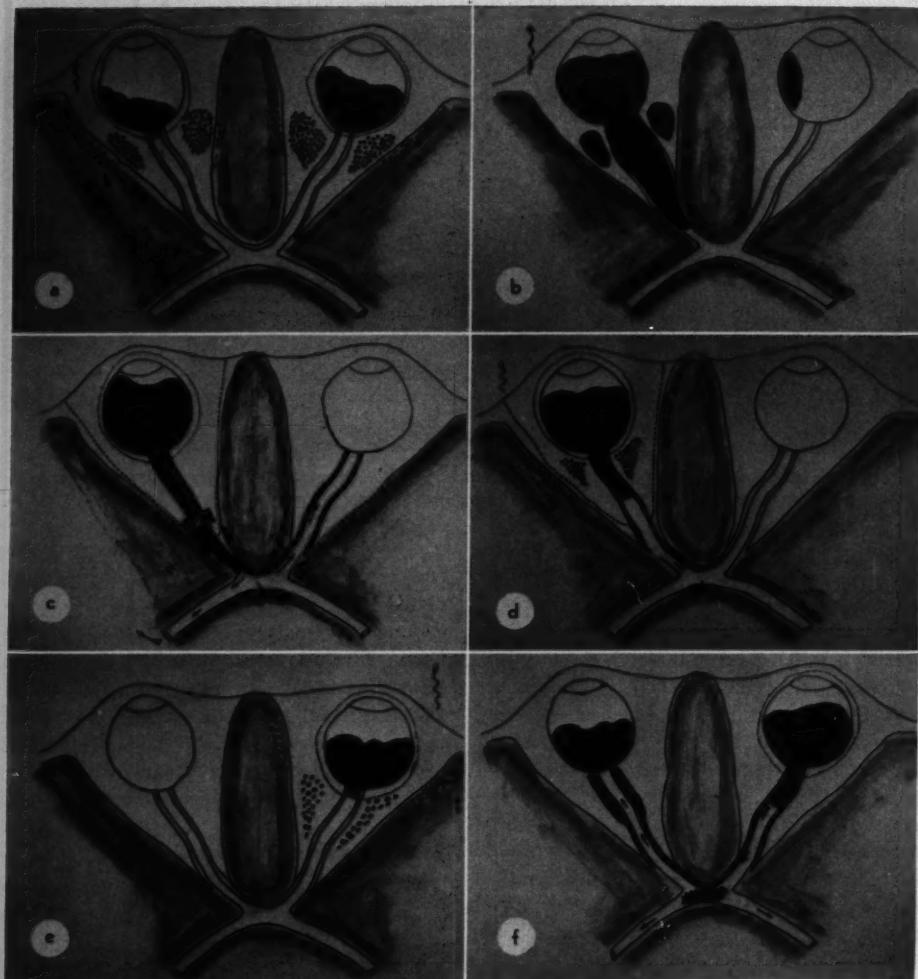


Fig. 14 (Carbajal). Diagrams showing size and location of tumor, surgical management, and metastases in this series. Please take note that the purpose of these diagrams is not to reproduce exactly the various metastatic pathways but rather to picture as clearly as possible the direction of such pathways. For example, what is implied when the nerve is shaded entirely black is the fact that the tumor cells have already reached a certain level. Various sections of the nerve may show varying degrees of involvement. The chiasmatic lesion in f is just in the subarachnoidal area. (a, b, c, d, e, f, are the first six cases with (a) standing for first case, (b) for second, and so on.)

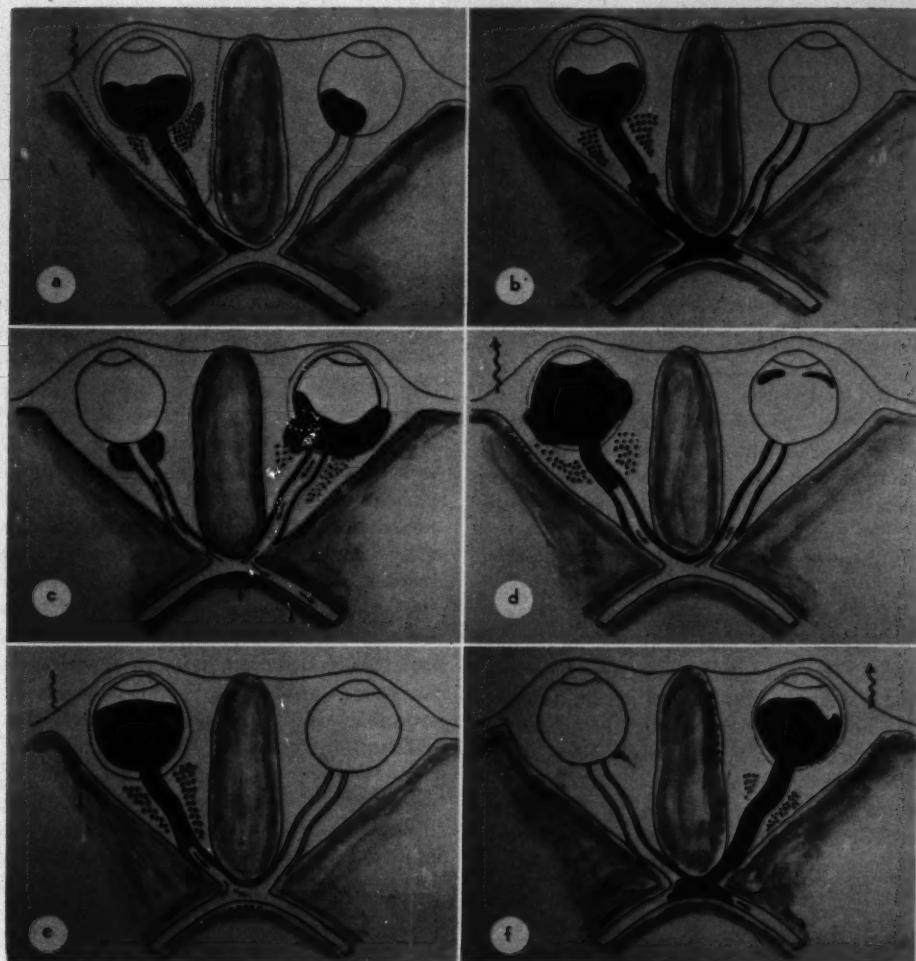


Fig. 15 (Carbajal). Diagrams illustrating routes of metastases in the other six cases, Case 7 to Case 12. (See Figure 14 for legend.)

was widespread dissemination of the tumor throughout the meninges of the brain, especially the subarachnoid space.

BONES

Involvement of the calvaria was shown in seven patients, both roentgenologically and at autopsy. As already mentioned, in one case there were three dark purple masses found in the calvarium, ranging in size from 1.0

cm. to 2.5 cm. in diameter and markedly hemorrhagic on cross section. These projected from the inner table of the skull and were palpable from the outside.

In this series, the skull was frequently affected by direct spread from the affected orbit (with recurrent tumor). Of the 12 autopsy cases, there were only two with no orbital recurrence, but in which metastasis to the calvaria was present. This must have



Fig. 16 (Carbajal). Section of the chiasm showing marked invasion by tumor cells. Case 8. (See Figure 15-b.)

been blood borne; for in all of the cases where the calvaria was invaded by tumor, there were distant metastases. On the other hand, in only one of the cases with distant metastases was the calvarium not invaded.

The metastases to distant bone are obviously by the hematogenous route, although, as in one case aforementioned, the vertebra was affected without obvious involvement of the viscera, other distant bones, and lymph nodes. The most commonly affected distant bones were the ribs and the vertebrae (table 8). These two bones are the most active in the hemopoietic system, especially in children, thus giving the tumor emboli a rich, nutrient bed. As shown in Figure 19, tumor cells outcrowd the various bone marrow cells. If bone involvement is severe, anemia can possibly result. However, the patients usually

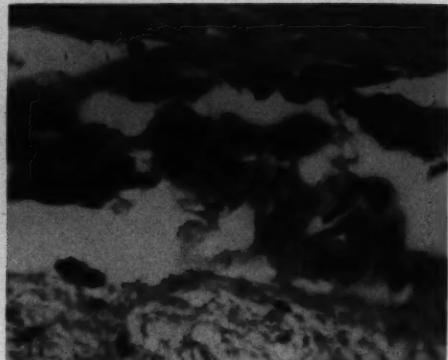


Fig. 18 (Carbajal). Section of the subarachnoid space of the spinal cord. There are a few clumps of tumor cells. Case 4.

die before this degree of bone metastasis is reached.

From the facts cited thus far, it may be safely concluded that orbital recurrence is associated with distant metastases; and that involvement of the calvaria (usually associated with orbital recurrence) is likewise associated with distant metastases. Intracranial metastases, on the other hand, need not be associated with metastases to the calvaria or to distant organs.

LYMPH NODES

In this series, as in most cases during autopsy, only the grossly involved nodes were



Fig. 17 (Carbajal). Inner portion of the lower half of the calvarium, showing erosion of the floor of the left anterior fossa (arrow). Case 4. (See Figure 14-d.)

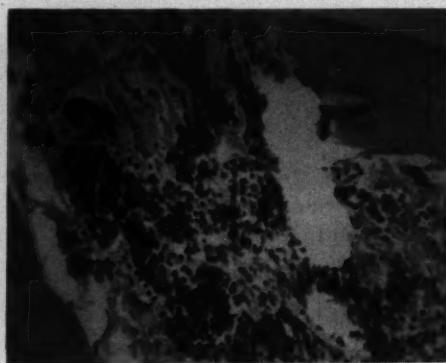


Fig. 19 (Carbajal). Section of the head of the humerus showing numerous tumor cells outcrowding the normal bone-marrow elements. Case 5.

TABLE 9
COMPARISON OF THIS SERIES WITH REPORTED SERIES

Metastases	This Series (12 cases)	Merriam's (17 cases)	Collected Cases (24 cases)
Skull bones	7 (58.3%)	9 (52.9%)	14 (58.3%)
Distal bones	6 (50.0%)	9 (52.9%)	6 (25.0%)
Spinal cord	3 (25.0%)	4 (23.5%)	6 (25.0%)
Lymph nodes	5 (41.6%)	8 (47.0%)	8 (33.3%)
Viscera	6 (50.0%)	8 (47.0%)	12 (50.0%)
Average percentage	44.9%	44.6%	38.3%

taken for sectioning, so that a complete picture of the widespread involvement of the lymphatic system is not depictable. As revealed in Table 9, obvious invasion of the lymph nodes was present in five cases or 41.6 percent. Involvement of the lymph nodes is due to lymphatic drainage from regional metastases. For example, the mesenteric nodes* were affected in two cases, where the liver was diffusely involved with tumor. In another case, the parotid nodes were involved after the onset of orbital recurrence. Still another was that previously mentioned, where a preauricular node was invaded by tumor two and a half months before enucleation of the affected eye. In one particular case, the posterior cervical, submaxillary, and supraclavicular nodes were almost completely replaced by tumor cells as the tumor recurred in the corresponding orbit. In this case, the periaortic nodes were completely infiltrated with tumor cells (fig. 20) and the adventitia of the adjacent portion of the abdominal aorta was invaded superficially. One may guess in this case that the lymphatic vessels and nodes were permeated with tumor cells beyond their capacity so that chain after chain of lymphatics was affected until the time came when tumor cells entered the blood circulation through the thoracic duct. It is unfortunate that this structure was not studied in this series. There is, of course, the strong possibility that the lymph nodes of the viscera were just filtering tumor cells from

the affected organ, which had previously become involved through the blood.

VISCERA

Invasion of various visceral organs was observed in six cases, (table 9), or 50 percent, an incidence higher than that usually found in the literature, and which is the same percentage as that of peripheral osseus metastases. The liver (fig. 21) was the organ most often affected, being involved in six patients or 50 percent. The other organs invaded, in the order of frequency, were as follows: Kidney, three cases; pancreas (fig. 22), two cases; spleen (fig. 23), one case; lung (subpleural space), one case; bile duct, one case. It is beyond doubt that metastases to these organs are hematogenous. In one case, the wall of the abdominal aorta was superficially invaded (fig. 24) by direct ex-

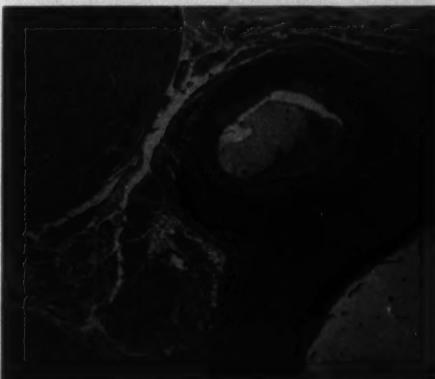


Fig. 20 (Carbajal). Section of the periaortic nodes which are diffusely involved with tumor. Case 4.

* The mesenteric nodes are supplied by the portal circulation.

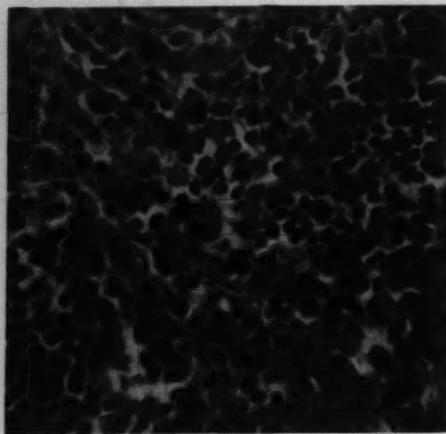


Fig. 21 (Carbajal). Section of liver showing invasion by retinoblastoma. Case 2.

tension from adjacent metastatic areas (lymph nodes).

The invasion of the liver was nodular in four patients and rather diffuse in two, but not sufficient to produce jaundice. In one, there was extensive necrosis and hemorrhage. In another patient in whom jaundice was clinically evident, the gall bladder was greatly distended due to an obstructive lesion of the intrapancreatic portion of the common bile

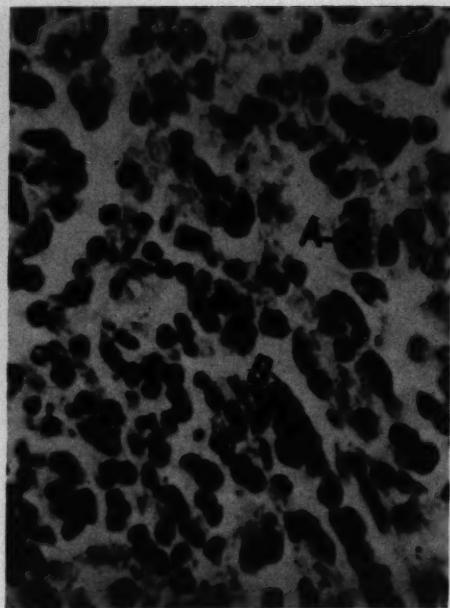


Fig. 23 (Carbajal). Section of spleen showing occasional tumor cells (A and B). Case 5.

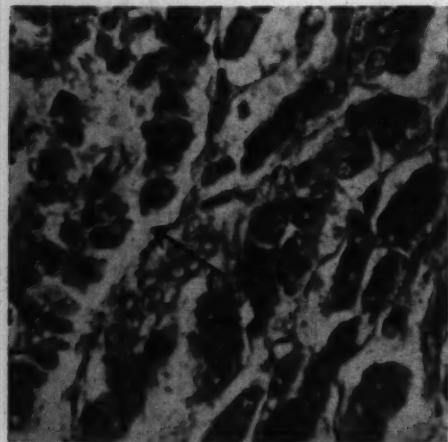


Fig. 22 (Carbajal). Section of pancreas showing tumor mass (arrow) adjacent to main part of pancreas. Case 7.

duct. In mild liver involvement, only a few tumor cells were seen wandering in the sinusoids, resulting in some compression of the liver cords; but in advanced cases, the architecture of the liver was completely lost as the liver cords were replaced by tumor tissue. In accord with Zulch¹² there was no true rosette formation in the metastatic nodules in the liver, although in a few sections there was what seemed to be a tendency to rosette arrangement.

The involvement of the kidney was easy to miss, as in each of the three cases with kidney metastases, not more than one metastatic focus was demonstrable. The tumor cells were seen in the collecting tubules in one.

In one patient, the head of the pancreas was completely replaced by tumor tissue; there were numerous nodules varying in size up to two centimeters in diameter. In another case, however, a fairly large area of tumor was noted to be adjacent to the pan-

creas, the tumor cells being distinctly separated from and not infiltrating the main pancreas substance (fig. 22).

For certain reasons already mentioned, the spleen is seldom involved by metastatic tumor cells. This is borne out in this series, as in only one patient was there shown some tumor cells in the splenic sinusoids.

Involvement of the lung by retinoblastoma metastatic nodules is rare. Only in one case was there involvement of the parietal pleura, in the apex of the left chest and along the inner surface of the 7th, 8th, and 9th ribs in the right chest. The actual lung substance, however, was not invaded by tumor cells.

Other visceral organs involved with retinoblastoma as found in the literature are testis, uterus, and ovary. The ovary was enormously enlarged in one of Merriam's cases.⁵

LOCAL INVASION

As long as the tumor remains within the globe, the tissues in and around the orbit stay free of tumor cells; but once outside the globe, the tumor will grow locally in the orbit, later invading the surrounding bones, even penetrating into the sinuses, the mouth, and the nose. In one case, the tumor might have invaded the brain through the cribriform plate. In none of the 12 cases was there spread from one orbit to the other through the nose. As has already been mentioned, in the six cases where the tumor spread to the other orbit, the passage was through the subarachnoid space around the involved nerve, via the chiasmatic cistern or chiasm itself and then into the opposite nerve (usually subarachnoid space only), forming a retrobulbar tumor (fig. 15-c) in the terminal stage of the disease.

The orbit may be involved in a number of ways. The tumor cells may escape along an emissary vein and reach the orbit; they may escape into the orbit from mechanical rupture of the globe; they may spill out from the cut end of the optic nerve during enucleation (from the subarachnoid as well as the nerve substance). It is possible also that the vessels



Fig. 24 (Carbajal). Higher magnification of area outlined in Figure 20. Arrows point at clumps of tumor cells.

and nerves behind the globe may have been invaded by a few tumor cells, and, when enucleation is done, some of them are spilled into the orbit. The role of lymphatic drainage in orbital recurrences is difficult to appraise.

ESTIMATED CAUSE OF DEATH

An attempt to explain the cause of death in this series of 20 fatal cases of retinoblastoma is shown in Table 10. Death in retinoblastoma was primarily due to intracranial metastases, the vital centers being embarrassed or compressed by metastatic lesions. Occasionally, infection (in the form of meningitis, esophagitis, or pneumonia) may hasten death.

MANIFESTATIONS OF METASTASES

The various manifestations of metastases in retinoblastoma as seen clinically are enumerated in Table 11.

Intracranial metastasis is heralded by nausea and vomiting due to increase in intracranial pressure. Signs of meningeal irritation (like restlessness, irritability, disorienta-

TABLE 10
ESTIMATED CAUSE OF DEATH IN 20 CASES

Cause of Death	Number of Cases		
	Autopsy series	Nonautopsy	Total
Intracranial (Internal hydrocephalus 4)	5	3	8
Generalized carcinomatosis	2	1	3
Local disease*	3	1	4
Massive peritoneal hemorrhage	1	0	1
Purulent meningitis	1	0	1
Anemia (severe)	0	1	1
Hard to determine	0	2	2
TOTALS	12	8	20

* Massive invasion of oropharynx, making respiration and deglutition impossible.

tation, and lethargy) were seen usually during the last few days of the patient's life. It is surprising to note that papilledema was frequently undetected in these patients with

signs of increased intracranial pressure. One explanation for this is that there is usually bilateral tumor involvement preventing visualization of the fundi. Another is that the

TABLE 11
CLINICAL MANIFESTATIONS OF METASTASIS IN 20 FATAL CASES OF RETINOBLASTOMA

Type of Metastasis and Manifestations	Number of Patients		
	Autopsy Series	Nonautopsy Series	Total
Intracranial			
Nausea and vomiting	4	2	6
Restlessness and irritability	4	2	6
Lethargy, disorientation, etc.	3	1	4
Convulsions	1	0	1
Large head	1	0	1
Visceral			
Marked abdominal enlargement			
due to peritoneal hemorrhage	1	0	1
due to liver enlargement	2	0	2
Mild to moderate enlargement	3	1	4
Anemia (pallor)	2	0	2
Jaundice	1	0	1
Orbit-to-orbit			
Papilledema	1	1	2
Blindness	2	0	2
Pallor of disc	1	0	1
Proptosis	1	0	1
Bones			
Trismus (mandible)	1	1	2
Swelling and dysfunction			
Radius and ulna (wrist)	1	0	1
Femur	0	2	2
Ilium	0	1	1
Nodes			
Marked swelling			
Parotid	1	0	1
Preauricular	0	1	1
Iliac and inguinal	1	0	1
Local			
Obstruction			
Oral cavity	1	0	1
Nose	1	0	1
Disfiguring mass, orbit	3	3	6
Bleeding from orbit	3	0	3

patient does not live long enough to allow papilledema formation. Third, in those with unilateral retinoblastoma involvement, the orbit-to-orbit type of metastasis may produce obliteration of the subarachnoid spaces. Mention was not made on actual ocular palsies from intracranial metastasis although there were a few with muscle imbalance. In the majority of cases, the muscle imbalance was one of the symptoms of retinoblastoma just starting, and not of metastasis. Of course, when the tumor ruptures the globe and escapes into the orbit, the eyeball will become more or less fixed. This was definitely manifested in one patient.

The actual demonstration of retinoblastoma tumor cells in the spinal fluid may confirm the presence of intracranial metastasis; however, failure to demonstrate tumor cells in the spinal fluid may not exclude the possibility of metastasis to the brain meninges. Also, X-ray examination of the skull may reveal an enlarged optic foramen or an enlarged superior orbital fissure, indicating that the tumor cells have travelled intracranially. Actual dehiscences of the orbital wall may indicate the same.

Visceral metastasis is chiefly manifested

by abdominal enlargement due to liver involvement. Jaundice is surprisingly rare. Marked abdominal enlargement can be brought about by enlargement of other organs, like the ovary, as in Merriam's series.⁵ Severe abdominal pain may indicate intra-peritoneal hemorrhage or compression of certain organs by markedly enlarged mesenteric or retroperitoneal nodes. Of course, young children often have difficulty in localizing the pain.

It is interesting to note that bone involvement is not suspected until there is definite swelling and dysfunction of the area affected. Even then, the X-ray findings may be minimal. Serum phosphatase studies were not made in this series.

Lymphogenous metastasis is seldom evident clinically. Only when the lymph nodes are considerably enlarged and superficial (like the parotid, preauricular, supraclavicular, iliac, inguinal) are they picked out in the physical examination of the patient.

Proximal metastasis or local invasion is preceded by recurrence of tumor in the orbit. Usually the recurrent mass is highly vascular and tends to bleed easily and profusely. In fact, one patient had to be taken to sur-

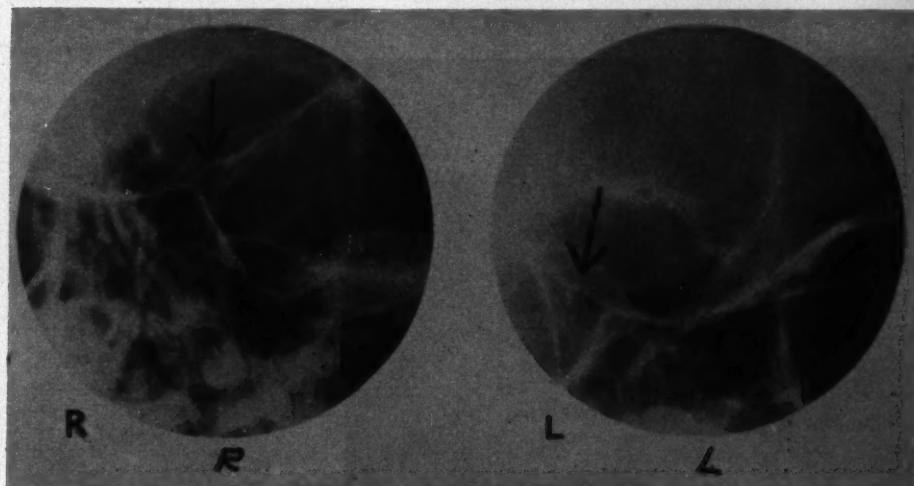


Fig. 25 (Carbajal). X-ray films showing moderate enlargement of the left optic foramen. Case 3. (See Figure 14-c.)



Fig. 26 (Carbajal). X-ray films showing early involvement of the radius and ulna. Case 7. (See Figure 15-a.)

gery for cauterization of the bleeders and for gel-foam packing.

ROENTGENOLOGIC FINDINGS

Roentgen-ray examination is invaluable not only in determining the presence of calcified foci in the orbit or enlargement of the optic foramen (fig. 25), but also in detecting proximal (orbit, cranium) or distal metastases (long bones, ribs, and sometimes

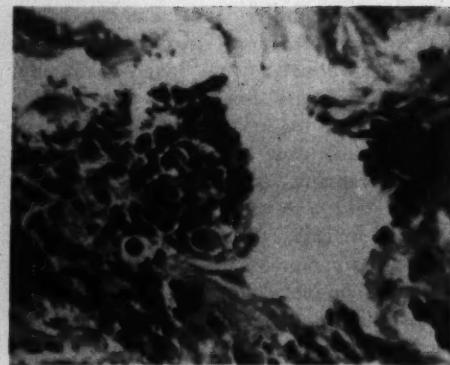


Fig. 28 (Carbajal). Section of head of humerus (higher magnification than in Figure 17), showing destruction of bone and replacement of normal bone marrow cells by tumor cells.

cranium). The bony changes in the early phase of metastasis are not easy to discern, the earliest evidence being just an irregularity of the cortical edge or a slight rarefaction of the subperiosteum (fig. 26). Later, attempts at subperiosteal bone formation and actual bone destruction (fig. 27) are obvious. Microscopic examination of the involved bone (fig. 28) often reveals overcrowding of the normal bone marrow cells by retinoblastoma cells and patchy bone destruction and/or formation. Pain, swelling, or stiffness



Fig. 27 (Carbajal). X-ray picture of skull showing destruction of bony orbit and also soft-tissue density produced by tumor.

of a joint should warrant radiologic investigation (bone survey) in patients who have undergone enucleation for retinoblastoma.

Moreover, invasion of the paranasal sinuses may be discovered early by X-ray examination. In the beginning, they may appear slightly hazy; but later, there is actual erosion of their walls (fig. 29).

TREATMENT OF RECURRENT TUMOR AND METASTASES

Deep X-ray therapy (six cases) and exenteration of the orbit (three cases) were tried in recurrent tumors of the orbit, but of no avail. All of the patients treated for metastatic lesions also suffered the same fate.

In the oldest patient in this series (fig. 30), excision of the optic nerve was performed eight days after enucleation or two days after exenteration. Moreover, deep X-ray treatment was instituted. This resulted in the prevention of orbital recurrence, but could not save the patient from intracranial metastasis.

Following an attempt at excision or exenteration, there is a tendency for the recurrent tumor to grow back wildly and rapidly. In one patient (fig. 31) the tumor recurred quickly, assuming monstrous proportions within a few weeks.



Fig. 29 (Carbajal). X-ray film showing sinus involvement.



Fig. 30 (Carbajal). Case 3, showing exenteration of the left orbit, with no evidence of recurrence.

Exenteration of the orbit with a recurrent tumor was always associated with excessive loss of blood, necessitating blood transfusion.

The main objective in trying to treat metastatic lesions is to make the patient more comfortable and less disfigured during the remaining weeks of life.

COMMENT

A comparison of the frequency of distant metastases in this series with that of Merriam's and with the collected series is shown in Table 9. There is definitely an agreement among the three with regard to the incidence of distant metastases. It is shown, therefore, that retinoblastoma is by no means the purely local and cranial disease it is so often considered; it is rather, a widely disseminated, extremely malignant new growth.

It is noteworthy in this analysis of 12 autopsy cases that all the patients showing orbital recurrence succumbed to the disease. The fact is established here that once the retinoblastoma cells have escaped from within the confines of the involved eye, fatality is 100 percent.

The treatment of metastatic lesions with radon seeds, deep X rays, excision, and other



Fig. 31 (Carbajal). Case 4, showing (a) recurrent orbital tumor five and a half months after enucleation and (b) rapid and wild recurrence after exenteration.

methods, has never proved effective in preventing death. Reese⁴ treated 34 patients with metastatic lesions over the body, and all died nonetheless. In this series, all the patients who had generalized retinoblastoma and who had been intensively treated succumbed ultimately. For this reason, in all enucleations for retinoblastoma, the surgeon should work with a pathologist who does frozen sections of the cut end of the nerve as well as of the structures (nerves, vessels, fat) in the adjacent retrobulbar area. Washings of the orbit and of the enucleated eyeball should be centrifuged and the sediment examined after Papanicolaou's method.¹⁸ Then, if there is evidence of extrabulbar extension, exenteration of the orbit and removal of the nerve as far as possible should be done immediately.

The exenterated orbit should be subjected to irradiation later to make sure that all viable retinoblastoma cells are completely destroyed.

Another point that should be emphasized is that all patients with fairly large retinoblastoma arising from the region of the nervehead should be treated as if they al-

ready had nerve involvement behind the lamina cribrosa. The affected eyeball should be enucleated, using a tonsil snare to insure excision of as much nerve as possible (fig. 32). As already pointed out, not only frozen sections of the cut end of the nerve should be done but also orbit and eyeball washings* for Papanicolaou staining. If exenteration is ever to be successful, it should be done right after enucleation or before the recurrence of tumor in the orbit.

I wish also to reiterate a previously published observation¹ that in bilateral retinoblastoma cases, early bilateral enucleation is the most effective way of preventing fatality.

Finally, it should be stressed once more that *early diagnosis* and *prompt treatment* are of prime importance in cutting down the mortality in retinoblastoma cases. Each retinoblastoma case should be handled as an emergency.

* This diagnostic procedure has just been started by Dr. Fisher²⁴ and me. It should be done in all enucleation cases in which the retinoblastoma tumor is close to the nervehead or to the area of the macula or vortex veins.

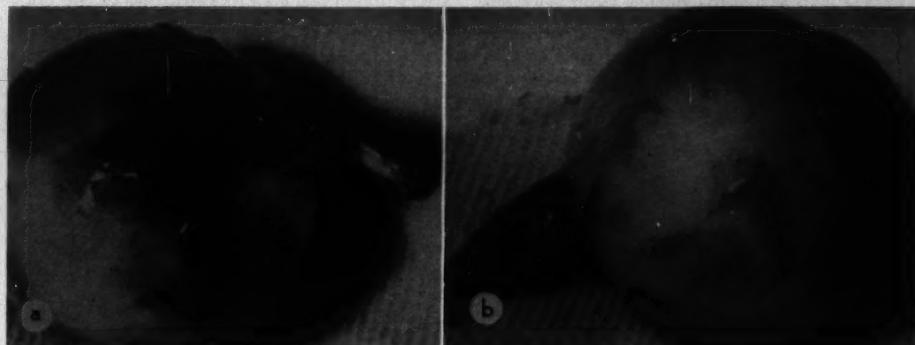


Fig. 32 (Carbajal). Enucleated eyeball, showing liberal amount of nerve excised when a tonsil snare is used. (a) The lateral-posterior portion of this left eyeball, showing the area of the macula and the ciliary vessels and nerves. (b) The medial aspect shows the superior and inferior vortex veins. See how close is the medial superior vortex vein to the optic nerve.

SUMMARY

Twenty patients dying from retinoblastoma have been studied and analyzed as to sites of metastases, including clinical manifestations, diagnosis, treatment, and prognosis. Pathologic findings in 12 cases undergoing autopsy are reviewed in an effort to explain the various routes of metastases and to find a solution to aid in diminishing the mortality in retinoblastoma cases. A new ap-

proach in the management of retinoblastoma patients undergoing enucleation is suggested.

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TREATMENT OF ENDOTHELIAL AND EPITHELIAL DYSTROPHY OF THE CORNEA*

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The first detailed slitlamp description of endothelial dystrophy of the cornea was given by Vogt¹ who coined the term "cornea guttata" for this condition. Endothelial dystrophy is best seen by means of retroillumination. However, details of the abnormal endothelial surface of the cornea are best observed in the zone of specular reflection. Histologically, the slitlamp appearance is due to excrescences of Descemet's membrane protruding into the anterior chamber. The excrescences form in the central part of the cornea and there is usually deposition of pigment in the endothelium.

Cornea guttata is a frequent finding in people over 50 years of age and, according to Goar,² is more common in women than in men. In the majority of cases the condition remains stationary for years. This fact has led many observers to believe that cornea guttata is only a manifestation of senescence of the corneal endothelium.

An association between epithelial dystrophy, as described by Fuchs in 1910,³ and cornea guttata was suspected by many observers (Vogt,¹ Kraupa,⁴ Friedenwald and Friedenwald,⁵ Kirby,⁶ Gifford,⁷ Clark,⁸ Goar,⁹ and Stocker¹⁰). Franceschetti¹¹ noted cornea guttata in one eye and edema of the stroma of the cornea with bullous keratopathy in the other eye of the same patient. These observers expressed the belief that epithelial dystrophy of Fuchs was secondary to disease of the endothelium.

This concept is well substantiated by histopathologic studies of eyes with Fuchs' dystrophy. Such studies were reported to date on 31 eyes by various authors (Vogt, 1930,¹² Von Hippel, 1932,¹³ Goar, 1934,⁹

Verhoeff, as reported by Lloyd in 1944,¹⁴ Calhoun, 1951,¹⁵ Stocker, 1952,¹⁶ and 1953,¹⁰ Irvine and Irvine, 1953,¹⁷ Irvine, 1956,¹⁸ Frayer, 1956,¹⁹ Wolter, Henderson and Gates, 1957,²⁰ and Chi, Teng, and Katzin, 1958²¹).

The more recent histologic studies made on flat preparations of the endothelium and Descemet's membrane, deserve special mention. Irvine and Irvine^{17,18} found that there is considerable variation in the concentration of the endothelial cells in the cornea. In normal corneas, the concentration of endothelial cells is about 15 percent less in the center of the cornea than in the periphery. This could explain why cornea guttata and bullous keratopathy appear first in the central part of the cornea. In bullous keratopathy they found the endothelial cells flattened and attenuated, their concentration reduced, and, in some areas, the endothelium was completely missing.

Wolter, Henderson, and Gates²⁰ examined the horizontal sections of a corneal disc removed for the purpose of corneal grafting. With the aid of special stains they observed wartlike excrescences in Descemet's membrane and round perforating defects in the endothelium overlying the excrescences. There was also widespread degeneration of the endothelium.

Chi, Teng, and Katzin²¹ studied flat preparations of 20 discs removed for the purpose of corneal grafting in cases of Fuchs' dystrophy. They found, with the aid of phase-contrast microscopy, protoplasmic globular bodies within the endothelial cells. The globular bodies distorted and displaced the nuclei, burst the boundaries of the cells, and fused in the space between the endothelium and Descemet's membrane. In cross section these fused globular bodies corresponded to the excrescences of Descemet's membrane. In

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some cases the cytoplasm of the endothelium was thinned over the excrescences, while in others the endothelium was entirely missing. Occasionally they observed a laminated membrane overlying the posterior surface of the original Descemet's membrane with excrescences between the two layers (duplication of Descemet's membrane). Pigment granules were found on the surface of the excrescences and within the endothelial cells. In the stroma the corneal lamellae were infiltrated by fluid. The epithelium showed intracellular and extracellular edema in the less advanced cases and subepithelial and intraepithelial bullae in the more advanced cases. The subepithelial bullae were filled with a coagulated mass and were more frequent than the intraepithelial bullae. Degeneration and regeneration of endothelial cells were seen side by side. Regenerated endothelial cells, derived from adjacent normal cells, migrated to cover degenerated areas.

The primary disease in Fuchs' dystrophy is therefore most probably in the endothelium. The etiology of the disease of the endothelium is unknown. Verhoeff, in discussing a paper by Levitt and Lloyd,²² expressed the view that the pathologic changes are the result of secretory overactivity of the endothelium undergoing senile degeneration. On the other hand, familial congenital endothelial dystrophy resembling clinically Fuchs' dystrophy was reported by Theodore.²³ The degenerative changes in the endothelium result in a defective barrier between the anterior chamber and the corneal stroma. Fluid enters the corneal stroma and ultimately damages the epithelium.

Under normal conditions the cornea is maintained in a state of deturgescence. There are two concepts which endeavor to explain the mechanism by which deturgescence of the cornea is maintained. The older concept, advocated by Cogan and Kinsey,²⁴ assumes that fluid flows from the perlimbal vessels into the stroma of the cornea and is constantly eliminated with the aid of an osmotic gradient into the hypertonic media

on both sides of the cornea (the precorneal film and the aqueous). The more recent concept is based on experiments by Harris and Nordquist,²⁵ Harris,²⁶ Harris and Gruber,²⁷ Davson,²⁸ Langham and Taylor,²⁹ and others. This concept assumes the existence of an active metabolic pump for elimination of water from the cornea. The water content of the cornea is also regulated by the state of the epithelium and endothelium, intraocular pressure, composition of aqueous, pH, and many other factors.

In Fuchs' dystrophy, fluid penetrates through the diseased endothelium into the stroma, which becomes waterlogged. The epithelial cells become vesiculated and subepithelial and intraepithelial bullae form. Waterlogging of the cornea is enhanced by abolition of the normal processes of elimination of fluid. Whether elimination of fluid is mediated by an osmotic pump or by an active metabolic process of secretion, it is most likely that the epithelium plays a major part in this process. In the advanced cases of dystrophy, the epithelium is so disintegrated that it cannot participate in the process of elimination of water from the cornea.

TREATMENT

Treatment of endothelial and epithelial dystrophy of the cornea is difficult and presents a real challenge. Many eyes have lost useful function as a result of uncontrolled hydration of the cornea. It appears that the most important problem in the medical treatment of Fuchs' dystrophy is to find a way of achieving effective and immediate dehydration of the water-logged cornea. Dehydration of the cornea should hasten repair of the damaged endothelium and thus re-establish the integrity of the barrier between the anterior chamber and the stroma. The endothelium has the ability to regenerate and also to form a new Descemet's membrane.²¹ Dehydration of the water-logged cornea also improves the condition of the epithelium thus favoring restoration of the normal process of elimination of fluid from the cornea. I ob-

served that in Fuchs' dystrophy, hydration of the cornea occurs in recurrent attacks. This is apparently due to the fact that new areas of endothelium become diseased after the previously defective areas healed by a process of repair.

While using glycerin for the purpose of examination in Case 1, it was noted that the patient was considerably improved the following day. Therefore, I decided to use glycerin at frequent intervals as a therapeutic means of obtaining dehydration of the cornea. Glycerin does not dehydrate large bullae or even small bullae, especially if they are of long standing, but it does remove a great deal of fluid from the corneal stroma. The eye is anesthetized with 0.5-percent tetracaine solution. Several instillations of glycerin are made in the lower cul-de-sac and the eye is patched snugly for 10 minutes in order to keep the glycerin in contact with the cornea. This treatment is repeated daily during the first week and every two days subsequently. After treatment with glycerin, scopolamine hydrobromide (0.2-percent) is instilled and the eye is patched with a pressure bandage. The cycloplegia and the pressure bandage add greatly to the comfort of the patient and hasten recovery.

In Case 1, the entire epithelium was separated from the rest of the cornea in the form of a large vesicle protruding through the lid margins. It was necessary to remove this giant bulla three times with a cotton applicator until a newly formed epithelium remained permanently attached. The same can be done with smaller bullae which resist dehydration with glycerin. It is true that dehydration of the cornea with glycerin is only temporary but, when glycerin is applied at frequent intervals, it improves the chances of early scar formation in the stroma and of early repair of the endothelium. The use of scopolamine and a pressure bandage is also an important adjuvant to the therapy with glycerin because it helps to combat the symptoms of keratitis. I advised occlusion during the night of the only seeing eye in Case 2 for

several months and obtained excellent visual results. Case 3 still requires occlusion from time to time for periods of one week.

It is not claimed that this treatment cures Fuchs' corneal dystrophy. The condition, if untreated, has a protracted course and is characterized by recurrent acute attacks of hydration of the cornea. Each attack causes additional damage to the cornea. In the terminal stages, the cornea becomes completely opaque and vision is lost, as seen in the right eye of Case 2.

The best that one can hope to achieve with this treatment is to shorten the periods of recurrent attacks of hydration of the cornea. This, in turn, minimizes visual loss by favoring early repair of the endothelium and epithelium. Shortening of the attacks also tends to confine the disease to the central portion of the cornea. In severe cases this is of great importance when a corneal transplantation is contemplated at a later date.

According to Stocker¹⁰ and Paton,³⁰ keratoplasty may be successful in cases of Fuchs' dystrophy if the endothelium of the peripheral part of the cornea is healthy and the graft is large enough to include all the diseased parts of the cornea. In mild cases the patients can be kept comfortable and the disease can be controlled by frequent examination and immediate treatment with glycerin, scopolamine, and pressure bandages as soon as signs of corneal hydration appear.

Following is a report of cases in which the outlined treatment produced encouraging results.

REPORT OF CASES

CASE 1

M. H., a 56-year-old white man, was seen for the first time in May, 1956, with a bullous keratopathy of the right eye and cornea guttata in the left eye. The right eye had a large epithelial bulla of the whole surface of the cornea which protruded between the eyelids and caused the patient great discomfort. Vision in this eye was correctible to 20/200. The left eye showed typical cornea guttata in the central area of the cornea and vision was correctible to 20/30.

The large bulla of the right eye was scraped off twice but the reformed epithelium failed to become firmly adherent. It was noted that after instillation

of glycerin for the purpose of getting a better view of the cornea, the eye improved the following day. Therefore, it was decided to scrape the epithelium again and treat the eye with daily instillation of glycerin and scopolamine followed by a pressure bandage. This time the newly reformed epithelium remained adherent over the greater part of the corneal surface after a few weeks' treatment. The cornea became thinner and there was some scar formation. Vision has remained 20/50, J2 with a +3.5D sph. addition. The eye has remained quiet and there have been no more episodes of abnormal hydration of the cornea.

In February, 1957, the left eye suddenly developed tearing and photophobia. There was hydration of the cornea and thickening of the stroma and a few small epithelial bullae developed. Treatment with glycerin, scopolamine, and a pressure dressing was started immediately. After one month of treatment, the stroma of the left cornea regained its normal thickness and there was minimal scar formation. The epithelium was well adherent except in the area of two small bullae which failed to disappear. Vision which dropped during the height of the attack to 20/70 returned to 20/30, J1.

CASE 2

L. S., a 60-year-old Negress, was first seen in October, 1956. Vision in the right eye was 20/400 and not correctible. She gave a history of prolonged treatment of the right eye in 1946. Her present complaint was a recent onset of blurred vision in the left eye.

On examination the right eye showed old scarring throughout the whole thickness of the cornea. The endothelium could not be seen but the epithelium was well adherent to the scarred superficial layers of the cornea. The left eye showed typical cornea guttata, hydration of the stroma, and subepithelial bullae. The best correctible vision was 20/50. A diagnosis of the terminal stage of Fuchs' epithelial dystrophy in the right eye and an acute attack of the same condition in the left eye was made.

The left eye was treated with glycerin and scopolamine. A pressure bandage was applied after working hours. The cornea remained cloudy between applications of glycerin; the epithelium appeared thickened and velvety and there were only a few bullae. Vision fluctuated between 20/40 and 20/80. After a number of recurrences of hydration of the cornea, the left eye quieted down and in September, 1957, at the end of one year of observation, vision was correctible to 20/30. The corneal stroma became slightly scarred and there has been no more hydration of the cornea since then.

CASE 3

E. O., a 69-year-old white woman, was first seen in January, 1954. At that time cornea guttata was diagnosed in both eyes. The corneal stroma and epithelium were normal. The right eye had an anterior and posterior capsular cataract and vision was reduced to counting fingers at four feet. The left eye had 20/80 vision with a +8.0D sph. The

lens was clear and the fundus normal. The patient was advised to delay cataract extraction on the right eye.

The patient was not seen until October, 1956, when she returned with a severely inflamed aphakic right eye. She had had cataract surgery on the right eye elsewhere in May, 1954, and had had a very painful eye since then. Upon examination, the right eye showed ciliary injection and many subepithelial bullae of the cornea. The left eye still had a clear lens, asymptomatic cornea guttata, and 20/80 vision. The patient was being treated by her surgeon with 2.5-percent suspension of hydrocortone and experienced a great deal of pain after each instillation. This is in line with my findings that local steroid therapy aggravates Fuchs' dystrophy.

The patient was treated with glycerin, scopolamine, and pressure bandages from October, 1956, to October, 1957. The treatment was not continuous because the patient stopped treatment periodically as she felt better. At present all epithelial bullae are flattened out and the eye is quiescent. There is some corneal scarring and only slight thickening of the stroma.

This is an example of the ill effects of cataract surgery in an eye with advanced cornea guttata, especially when a limbal section is made and the lens is extracted in the capsule by tumbling or with the erisophake, both of these methods being injurious to the vulnerable corneal endothelium.

CASE 4

B. C., a 52-year-old white woman, had bilateral cornea guttata with mild attacks of corneal hydration, cloudiness of the stroma, and thickening of the epithelium which appeared velvety and stained with fluorescein. There was no formation of epithelial bullae. With each attack of hydration of the cornea there was blurring of vision, photophobia, and pain. The patient was treated during each attack with glycerin, scopolamine, and a pressure bandage on both eyes during the night. From December, 1956, to the present, she has had three mild attacks, each of which cleared within 10 days after treatment was started. Between attacks there is remarkable improvement of the condition with normal vision. No permanent scarring of the cornea is visible at this time.

CASE 5

L. C., a 60-year-old white woman, had pronounced cornea guttata. Vision was 20/25 in each eye. There are no symptoms and there have been no attacks of hydration of the cornea since she was first seen in March, 1957. This is an example of a severe case of cornea guttata without attacks of hydration of the stroma. I have observed many mild cases of cornea guttata which have remained asymptomatic for years.

SUMMARY AND CONCLUSIONS

1. Cornea guttata and its relation to Fuchs' epithelial dystrophy are discussed.

2. Histopathologic changes in Fuchs' dystrophy are described.

3. Two concepts explaining deturgescence of the cornea under normal physiologic conditions are outlined.

4. Disease of the endothelium is considered the primary cause of Fuchs' dystrophy. Hydration, swelling, and clouding of the stroma are followed by the formation of both intra-

epithelial and subepithelial bullae.

5. The use of glycerin, scopolamine, and pressure bandage is suggested for the treatment of hydration of the cornea in corneal dystrophy and cornea guttata. I have found that this treatment shortens the duration of hydration and restores improved function of the endothelium and epithelium.

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BLEPHAROPTOSIS*

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In spite of the many different surgical procedures recommended for the correction of ptosis, it is still one of the unsolved problems in ophthalmology and, for this reason, surgeons are still on the search for new modified surgical procedures to improve function and cosmetic appearance. So far, not one operative procedure is ideal, partly because of the complicated and varied nature of ptosis.

My purpose in presenting this paper is to discuss my experiences and what might have been the possible causes of early and late failures or undercorrections in ptosis operations according to the Pagenstecher or Friedenwald-Guyton techniques and their modifications.

My experiences are based on 38 cases: eight bilateral and 30 unilateral, a total of 46 eyelids. Six were corrected by levator resection; one tarsus to the superior rectus muscle; one orbicularis to frontalis; 12 tarsus to frontalis with the use of a fascia latae sling; and 26 tarsus to the frontalis with the use of 2-0 Deknatel silk.

In grading my results, I use the criteria of C. Cordes Johnson with a slight modification. Of the 26 eyelids operated with the use of sutures I have had the following results: three unimproved (U); 15 fair (F); and eight good (G).¹

The frontalis muscle type of ptosis operation in which the lid is suspended from the eyebrow, thus utilizing the lifting power of the frontalis muscle to support the upper lid with the use of sutures, seldom gives very good results especially in unilateral ptosis. However, this procedure is the operation of choice in bilateral complete ptosis associated with paralysis of ocular elevation with little

or no levator action.¹ The descriptions of the different techniques using sutures referred to in this paper are purposely omitted as they can be found in books^{1,3-5} and journals.^{1,6-8}

When the frontalis muscle type of ptosis operation is indicated the use of sutures suspending the tarsus to the frontalis is my operation of choice because (1) it is the simplest and easiest procedure; (2) it has the least inflammatory or traumatic reactions and consequently the least number of days of hospitalization (in my cases the patient is confined only 24 hours and, if adjustment is necessary, it is done after 48 to 72 hours after which the patient is discharged from the hospital); (3) usually, the anesthesia is local except in very young children; (4) it can be a primary or a secondary surgical procedure; (5) it is more economical than any other procedure (less number of days in the hospital and local anesthesia is usually inexpensive); (6) postoperative correction is almost immediate.

To appreciate and understand the mechanics of this procedure, a superficial review of the anatomy of the eyebrow is presented. In each eyebrow, four principal layers can be identified in a midvertical section:⁹

1. The skin which is intimately united to a dense superficial fascia.

2. The muscular layers comprised of three orders of fasciculi: the vertically directed fibers of the frontalis, the concentrically arranged fasciculi of the orbicularis, and the obliquely placed corrugator supercilii. These fibers intermingle and are inseparable at their insertion into the skin. The frontalis muscles are the anterior bellies of the epocranius or occipitofrontalis.

3. The cellulo-adipose layer underlies the muscles and facilitates the movement of the eyebrow over the orbital margin; it is fairly loose, and contains fat in its meshes; it is

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abundant in the lower part of the eyebrow (subepicranial layer).

4. The galea aponeurotica (epicranial aponeurosis). This splits anteriorly to enclose the frontalis muscle fibers to the skin of the eyebrow, while the deeper and more definite layer passes beneath the muscles and is firmly attached to the supraorbital margin.

These four layers—skin, muscle, connective tissue, and aponeurosis—constitute the eyebrow proper. Their close union is exactly similar to what is found in the scalp proper of which this region is as already noted, merely a specialized portion.

Frontal periosteum beneath the subepicranium adheres to the surface of each of the bones and consists of two layers: the outer, chiefly of connective tissue containing occasionally a few fat cells; and the inner layer, chiefly of elastic fibers of the finer kind, forming dense membranous networks.¹⁰

It has been stated that suspension from the frontalis is "an operation of fixation rather than motion." This is partly true.¹ In my opinion, the mechanics of this procedure is a combination of fixation and motion. With the sutures properly placed in the tarsus and in the frontal periosteum in their bite through the frontalis, the upper eyelid is suspended at a calculated height above the pupil as the frontalis muscle remains relaxed, in which case there is still some degree of ptosis. It can be assumed that the attachment of the frontalis muscle to the tarsus is at the insertion so that, when the muscle contracts, it lifts the tarsus, thus raising the edge of the lid just below or at the level with the limbus at the 12-o'clock position, while its attachment at the frontal periosteum acts as an anchor, it remaining fixed. In this case the ptosis is overcome by elevating the eyebrow.

As can be gleaned, the initial elevation of the upper eyelid is mechanical (fixation or suspension of the lid to the frontalis at certain height), while its subsequent and further elevation is physiologic (due to the lifting motion of the frontalis muscles).

In spite of the knowledge of the anatomy

of the eyebrow and the mechanics of this surgical procedure, some of my results were unsatisfactory. What could have been the pitfalls? Possible causes of early and late failures or undercorrections might have been:

1. A poor estimate as to how much the lid should be elevated. (The immediate end-result should present a lagophthalmos with the eyes straight to the front; the lid margin should be at the level or above the limbus.⁵)

2. Sutures when tied too tightly may cut through the tissues thus decreasing the estimated degree of lid elevation.

3. Early activity of the operated lid may give insufficient time for the formation of the necessary cicatricial bands to hold it at the intended height.

4. Failure to scoop the frontal periosteum while anchoring the suture in eyebrow. Gravity and the weight of the lid will bring the lid down in the course of time if it is not properly anchored.

5. Early and late postoperative infections.

COMMENT

It has been my observation that a patient with bilateral ptosis, without levator action, usually uses his eyebrow to the maximum in his effort to raise the lid. However, when ptosis is unilateral, he is less likely to do so but raises the lid just enough to expose the pupil to maintain binocular vision. After the correction, however, the action of the frontalis becomes minimal and often times hardly noticeable because the sutures which suspend the lid initially have already exposed the pupil so that contraction of the frontalis is no longer necessary in order to maintain binocular vision.

If the lid is not attached high enough to expose the pupil, the frontalis must be contracted to elevate it properly. This calls for a continued monocular contraction which develops into a disfiguring unilateral frontalis hypertrophy. If the ptosis is completely corrected, with the eyebrow in relaxed position, there will be a dangerous lagophthalmos which is undesirable.

SUMMARY

This is a preliminary report on 38 cases of ptosis in which 46 eyelids were operated by various surgical procedures of which 26 eyelids were corrected with the use of sutures suspending the eyelid to the eyebrow. This paper emphasizes the possible pitfalls that

might have caused early and late failure in my own cases—pitfalls which may also apply to the experiences of other surgeons who use sutures in the frontalis muscle in ptosis operations.

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ELECTROPHORETIC STUDY OF MAMMALIAN AND AVIAN CORNEAL PROTEINS*

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In a recent study, Basu and Ormsby¹ found that by using interlamellar heterografts in rabbits, the percentage of immunologic reactions varied greatly when corneas from different species were used. It was also seen in these experiments that bovine cornea was the most antigenic, and chicken least antigenic, when rabbits were used as test animals.

Further investigation² carried out to study antigenic properties of corneal tissue by immunologic methods (using electrophoresis and gel diffusion techniques) showed that the most antigenic corneal extracts were those which had higher concentration of proteins in the region of fractions III and IV on electrophoresis strips.

The purpose of this present study was to

compare by electrophoresis the corneal proteins from different mammalian and avian species, in order to find the corneal tissues showing the smallest antibody stimulating protein fractions.

METHODS

The procedure for extracting corneal proteins and the technique of electrophoresis were described in our previous paper.²

MATERIALS

Corneal extracts containing 3.4 percent total proteins were made from the following tissues:

1. Fresh tissues
 - a. Monkey whole cornea
 - b. Beef cornea with and without epithelium
 - c. Lamb cornea with and without epithelium

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- d. Rabbit cornea with and without epithelium
- 2. Stored cornea
 - a. Human whole cornea stored at -79°C . for six weeks
 - b. Chicken whole cornea stored at -4°C . for 10 hours

In the case of human and chicken corneas, storage of tissues was necessary because of an insufficiency of fresh material for testing at any one time.

RESULTS

1. Protein content was found to vary in corneal extracts from different species. The (antibody stimulating) fractions III and IV were highest in bovine corneal extract and decreased in the following order, lamb, monkey, human, chicken, and rabbit. Monkey and human corneas showed a very close similarity to one another.

2. Fraction I (containing mucopolysaccharide) was found to vary in different species, and in general showed an inverse ratio to fractions III and IV, being highest in chicken and rabbit, intermediate in human and monkey, and lowest in beef corneas.

3. In beef and lamb corneas, removal of epithelium resulted in relatively higher concentrations of fraction I and in relatively lower concentrations of fractions III and IV.

DISCUSSION

In our previous paper,² it was pointed out that extracts which showed intensification of the bands in the regions of III and IV by electrophoresis, were most antigenic when injected into rabbits. This was shown when antisera were tested against these extracts by gel diffusion techniques. These antisera showed in addition an increase in the region

of gamma globulin by electrophoresis.

The results of the comparative study by electrophoresis of fractions III and IV would suggest that chicken and rabbit corneas might be more suitable for grafting than either bovine, human, or monkey donor tissues, insofar as immunologic reactions were concerned.

We also noted in previous experiments that fraction I (containing acid mucopolysaccharide) could be demonstrated in corneal tissues in varying amounts. It has been suggested by Wyburn⁴ that mucopolysaccharides have a protective effect against antibody penetration into tissue. Thus the combination of low concentrations of antigens and relatively high concentrations of mucopolysaccharide in rabbit and chicken corneas might make these tissues very suitable from grafting.

In bovine and lamb corneal extracts, relatively more acid mucopolysaccharide was present after removing epithelium, whereas antigen stimulating fractions were reduced, tending to confirm our previous impression that epithelium should be removed from donor tissues prior to grafting.

CONCLUSIONS

1. By electrophoresis, the antigen stimulating fractions III and IV were highest in bovine corneal extracts, lower in human and monkey, and least in chicken and rabbit.

2. Acid mucopolysaccharide in general showed an inverse ratio to the antibody stimulating fractions, being lowest in bovine, and highest in rabbit and chicken corneas.

3. These findings suggested that rabbit and chicken corneas might be suitable for heterografts.

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SUTURES AND INCISION IN CATARACT SURGERY

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I have previously reported about lid sutures for the relief of pressure on the eye.³ Their main feature consists of double-armed mattress sutures inserted at the upper lid margin and passing upward through the epitarsal tissue. The temporal suture should pull the outer canthus away from the eye at an angle of 45 degrees. Further, superficial skin sutures are passed at the middle of the upper and the lower lid margin. The epitarsal sutures are removed at the end of the operation. The upper medial suture is used for closing the lids. The lower medial suture is secured to the cheek without pull. It will become useful when entropion of the lower lid is encountered at the first dressing.

Next comes the preplacement of the McLean corneoscleral suture. A two-mm. limbus-based conjunctival flap is prepared at A, (fig. 1) and a groove is made at the upper limbus with the help of a Bard Parker knife No. 16. If the surgeon prefers the Graefe knife section to the use of keratome and scissors the conjunctival incision and the limbal groove have to be extended down to B (fig. 1). The nasal side of the limbus is left alone. Now, a fine surgical suture wire, which is kept taut between the branches of a fork, is inserted into the groove. Stranded Danico stainless suture wire is suitable. A black silk thread may also be used; it is however liable to be split by the corneal needle (fig. 2).

The appositional suture is passed in one bite through the scleral and corneal lip of the groove above the wire (figs. 3 and 4).

The insertion of the wire insures good fixation and prevents the corneoscleral suture being placed too deep. The suture is lifted out of the groove by the wire, pulled aside, and the wire is cut. It is not necessary to pass the suture first through the conjunctival flap as this may result in buttonholing

the flap during the operation. It can be done after the delivery of the lens if the scleral end of the suture is armed with a conjunctival needle. When, however, vitreous loss becomes imminent or actually happens, the suture has to be tied quickly without much regard for the conjunctival flap.

The section can be made with a keratome and enlarged with scissors as originally practiced by Jacques Daviel at the lower limbus. For the v. Graefe knife section the conjunctival incision and limbal groove have to be extended at the temporal side down to the horizontal meridian as already mentioned. The knife enters the anterior chamber at the horizontal end of the limbal groove. As special care has to be taken not to cut upward along the groove before the counterpuncture is made the tip of the knife is first

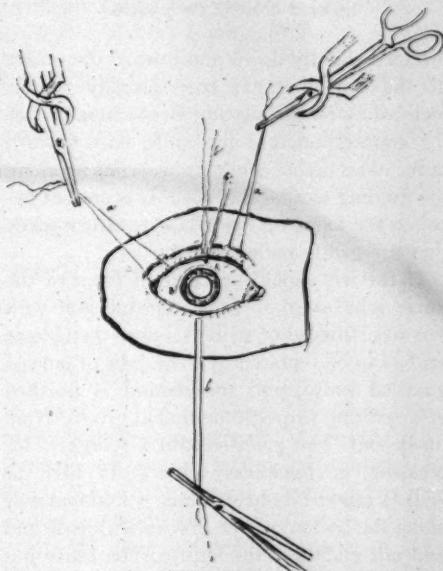


Fig. 1 (Lyttion). Right eye. (a) Epitarsal sutures. (b) medial sutures. (c) Superior rectus suture. (AB) Line of conjunctival incision.

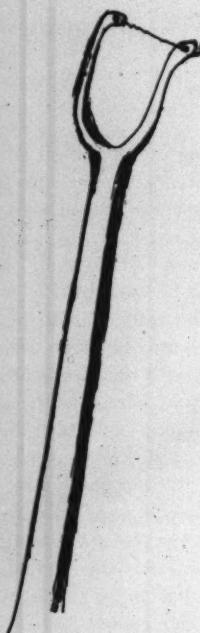


Fig. 2 (Lyttton). Fork with wire extended between holes in its branches.

directed slightly down and toward the center of the eye as it has been already recommended by Grimsdale and Brewerton.² After the counterpuncture the knife cuts upward at the nasal limbus while its heel runs up along the guiding temporal groove. It is cut out between the loops of the McLean suture while they are gently pulled apart.

If the iris should prolapse in front of the knife it is usual to finish the incision with scissors. Instead of using scissors the Graefe knife can be replaced by a straight or curved guarded knife, and the section is finished after cutting through the limbal groove from inside out. The guarded knife is slightly increasing in thickness toward its back as well as toward its heel. Thus, it finds its way along the bottom of the groove with ease and will not endanger the suture. The knife has to be very sharp. It should cut and not pull and tear (figs. 5 and 6).

In case of the blunt knob of the knife be-

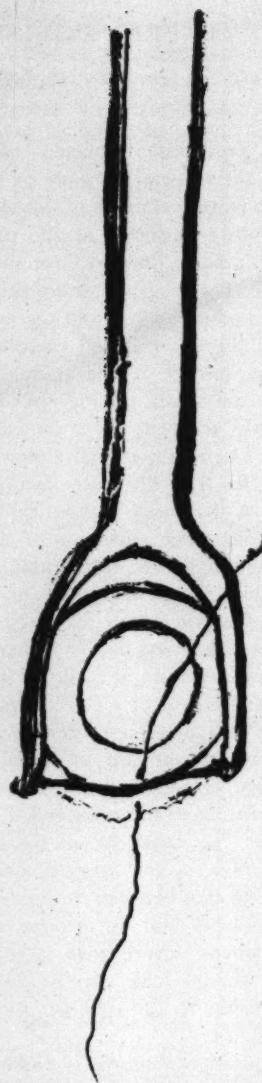


Fig. 3 (Lyttton). Wire inserted into the limbal groove.

coming entangled in the iris when the instrument is introduced in the anterior chamber it should not be pushed to the other side of the limbus but the knob is directed into the angle of the anterior chamber, and the section is finished slowly along the limbal

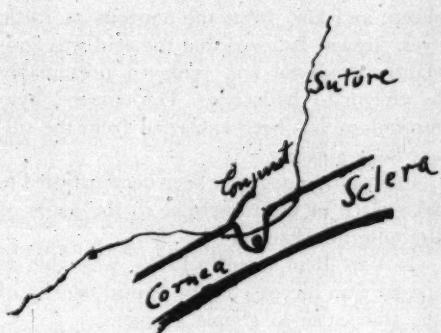


Fig. 4 (Lytton). Cross section of the limbal groove, showing the wire at the bottom of the groove. The deeper the suture the more likely it will be cut by the section.

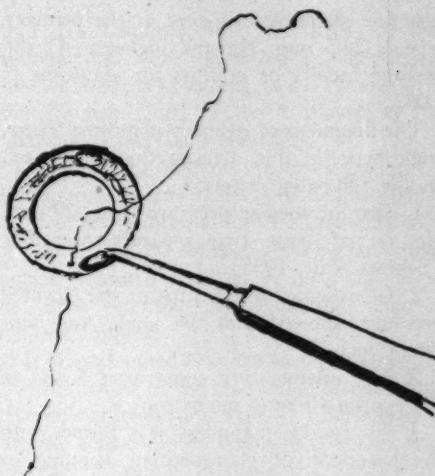


Fig. 6 (Lytton). Section completed with the curved guarded knife.

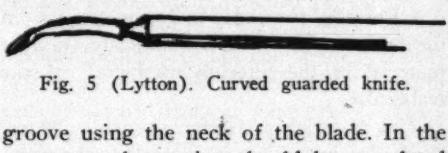


Fig. 5 (Lytton). Curved guarded knife.

groove using the neck of the blade. In the same way the section should be completed with the guarded knife if the Graefe knife in its upward movement has left the limbal

groove and threatens to cut the corneo-scleral suture.

The ab-interno knife incision is smooth and is free from the danger of pressing epithelium into the wound.

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PRIMARY GLAUCOMA: OPEN-ANGLE TYPE*

AN EXPERIMENTAL INVESTIGATION ON A NEW THERAPEUTIC APPROACH IN THE TREATMENT OF SIMPLE CHRONIC GLAUCOMA

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Primary glaucoma is a disease of the eye in which the intraocular pressure is raised to a sufficient degree so that the optic nerve loses function. The etiology is unknown.

The normal intraocular aqueous dynamics, according to Prof. Goldmann,¹ are: (1) 14.2

mm. Hg \pm 1.83 pressure; (2) the average normal outflow pressure is 5.0 mm. Hg; (3) the average outflow facility is between 0.10 and 0.21; (4) the normal volume of flow per minute is about 1.9 mm.³

Dr. W. Morton Grant's² figures are: (1) 13.5 mm. Hg for the normal average eye pressure; (2) the average facility of outflow is 0.233; (3) the average intraocular pres-

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sure for glaucomatous eyes of the primary type is 28.5 mm. Hg and higher; (4) the average facility of outflow for glaucoma is 0.082.

The diagnosis of primary glaucoma, open-angle type, in this investigation was based on the following criteria:

1. The intraocular pressure reads 29 mm. Hg on at least two separate occasions (Schiøtz scale, 1955).

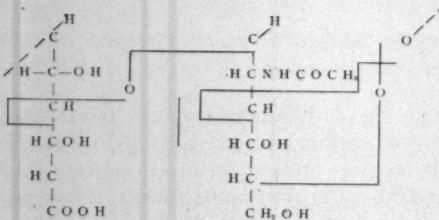
2. Gonioscopy, at the time of the elevated pressure, showed that the angle was definitely open.

3. No inflammatory signs were found in the eye on slitlamp microscopy.

4. No fundus pathology was found, with the exception of glaucomatous cupping or atrophy of the optic nerveheads.

It is believed that the ciliary body produces the aqueous which collects in the posterior chamber and flows through the pupil into the anterior chamber, then through the trabeculae into Schlemm's canal, and from Schlemm's canal through the collecting channels into the veins. Obstruction to this outflow of aqueous from the eye produces the increased intraocular pressure. The site of this obstruction is either in the trabeculae or in the collecting channels. We believe hyaluronic acid is the substance which "clogs" the pores of the trabeculae or the collecting channels, thereby causing the increased resistance to the outflow of the aqueous.

Hyaluronic acid is believed to have the following formula:



A gel formed from hyaluronic acid serves partly as a "cement" which holds the cells together. Hyaluronic acid has been isolated from the vitreous humor of cattle, swine,

sheep, and also from the aqueous of cattle eyes. Meyer⁸ believed that the acid was constantly produced and removed presumably by enzymatic hydrolysis. The enzyme, hyaluronidase, has been extracted from the ciliary body and iris.

Certain changes have been demonstrated to take place in the trabeculae in the angle of the anterior chamber.

1. Van Beuningen⁴ (1951) was able to measure an increase in the optical density of the trabeculae in simple glaucoma.

2. Barkan⁵ (1938) claimed that sclerosis existed in the trabeculae in simple chronic glaucoma.

3. Bangerter and Goldmann⁶ observed, gonoscopically, a "felting" of the uveal trabeculae in many cases of simple glaucoma.

4. Persson⁷ succeeded in demonstrating (in the human eye) metachromatically staining material in the filtering meshwork of the trabeculae.

This material is extremely sensitive to testicular hyaluronidase in contrast to the metachromatic material of the cornea. The metachromatic material of the cornea has a sulfate-containing derivative of hyaluronic acid.

Zimmerman⁸ has demonstrated an hyaluronidase-sensitive mucopolysaccharide in the trabeculae. Vrabec⁹ has also demonstrated the effects of hyaluronidase on the trabeculae and has followed it up with microphotographs. Berggren and Vrabec¹⁰ have clearly demonstrated that hyaluronidase decreases the resistance of the trabeculae to the aqueous.

A report by Garron, Feeney, Hogan, and McEwen¹¹ on electron microscopy of the human eye states that the endothelial cells of the trabeculae fail to show the same excellence of cytoplasmic detail as the nearby muscle cells of the ciliary body. If there is a film of hyaluronic acid coating the trabeculae, it could account for the apparently poor fixation of these endothelial cells. However, the presence of hyaluronic acid is not ordinarily demonstrable with the electron micro-

scope. Hyaluronic acid is very labile and is subject to a variety of influences. Hyaluronidase, the enzyme, causes hydrolysis of the glucosaminidic bond of the hyaluronic acid and produces a marked reduction in the viscosity of solutions of hyaluronic acid.

Bárány¹² and others have shown by experiments on animal eyes that the injection of hyaluronidase could produce a drop of almost 50 percent in the intraocular pressure. This is true of rabbit, cat, and pig eyes. They have also shown that if trigentisic acid, which inhibits enzymatic action, is injected into the eye prior to the use of the enzyme, there will be no drop in the intraocular pressure. Marinchev,¹³ in Russia, injected hyaluronidase into the human eye and also found a 50 percent drop in the intraocular pressure.

Becker¹⁴ stated that normalization of the outflow facility provides one of the best buffers against rises of intraocular pressure and glaucoma damage. Conversely, inadequate normalization of the outflow facility significantly decreases the chances of continued control. The evidence seems to indicate definitely the presence of a mucopolysaccharide component in the trabecular meshwork.

At the Brooklyn Out-patient Clinic of the Veterans Administration, we have examined 12,000 veterans in the eye clinic in the past four years. This past year we examined 3,062 veterans. Seven hundred and six were found to have an intraocular pressure of 20

mm. Hg (Schiötz, 1955) or over; of this number 156 were diagnosed as having primary glaucoma according to the criteria previously mentioned. Table 1 illustrates the analysis of the last 1,178 cases.

At the beginning of the investigation by iontophoresis of the effects of hyaluronidase on primary glaucoma, we chose patients with vision of 20/200 or less, showing an intraocular pressure of 30 to 40 mm. Hg. Most of these veterans showed definite glaucomatous cupping.

It was assumed that the material clogging the meshwork of the trabeculae or collecting channels is hyaluronic acid. If sufficient hyaluronic acid could be removed from the trabeculae, it would increase the facility of aqueous outflow. Hyaluronidase has been used as a spreading factor in other conditions, especially in hypodermoclysis. We, therefore, attempted the removal of hyaluronic acid by introducing hyaluronidase into the aqueous by iontophoresis.

Using a plastic eye cup, we introduced hyaluronidase by iontophoresis. The eye electrode is similar to the one used in retinography. During the one minute application of one milliampere of galvanic current, we noticed that (gas—?) bubbles formed in the solution near the cathode. After the cup was removed, the cornea was examined by slit-lamp microscopy and showed some haziness, filamentary epithelial strands, and staining with fluorescein. An antiseptic ointment was

TABLE 1
INTRAOCULAR PRESSURE (SCHIÖTZ) FROM CALIBRATION SCALE APPROVED BY THE
COMMITTEE ON STANDARDIZATION OF TONOMETERS

Age (yr.)	Pressures (mm.Hg)					Glaucomatous Eyes	Normal Eyes	Total Eyes
	20-24	25-29	30-34	35-39	40+			
60-64	366	54	16	11	18	465	918	1,383
65-69	471	130	21	13	21	656	1,513	2,169
70+	35	13	3	2	4	57	191	248
Totals	872	197	40	26	43	1,178	2,622	3,800

Eyes with pressure over 30 mm. Hg (Schiötz).....	109
Total number of eyes examined.....	3,800
Suspected eyes (1958).....	1,178
Definite cases of diagnosed glaucoma.....	156

TABLE 2*
INTRAOCULAR PRESSURE AFTER IONTOPHORESIS WITH HYALURONIDASE

Case No.	Eye	1st Day	3rd Day	1st Week
1 L. C.	OD—1/5.5=34.5	4/515=20.6	5/5.5=17.3	5/5.5=17.3
2 W. L.	OS—5/10=37	5/10=37		6.8/10=27.2
3 H. H.	OS—7/10=48	2.5/5.5=26.6	2 5/5.5=26.6	2/5.5=29
4 H. J. Mc.	OD—1.5/5=31	5.5/7.5=23.8		5.5/7.5=23.8
5 R. N.	OD—5/7.5=25.8	5/5.5=17.3		5/5.5=17.3
6 F. A.	OS—2/5.5=29	3/5.5=24.4		6/5.5=14.5
7 S. P.	OS—2/5.5=29	6/5.5=14.6		6/5.5=14.6
8 H. Mc.	OD—2.6/7=38.8	5/5.5=17.3	5.5/7.5=17.3	
9 A. D.	OS—5.5/10=34.4	2/5.5=29	7/5.5=12.2	
10 S. L.	OD—4/7.5=30.4	5.5/7.5=23.8	4.5/5.5=18.9	
11 W. H.	OS—4/10=43.4	4/5.5=20.6	4/5.5=20.6	
12 W. H.	OS—6/10=31.8	5/5.5=17.3		
13 J. L.	OD—1.5/5.5=31.6	5/5.5=17.3		
14 Z. K.	OS—4.5/10=40.2	4/5.5=20.6		
15 J. A.	OS—5/10=37.2	6.5/10=29.4		
16 E. D.	OS—6/10=31.8	7/10=27.2		
17 G. D.	OS—4/7.5=30.4	4/5.5=20.6		
18 J. P.	OS—3.6/10=44.6	2.4/5.5=26.6		
19 P. S.	OD—4.8/10=40.2	1.5/5.5=31.6		
20 S. W.	OS—2/5.5=29	3/5.5=24		

* This table illustrates an approximate 50-percent drop in intraocular pressure following iontophoresis with hyaluronidase.

instilled and the eye was patched. Twenty-four hours later, on removal of the patch, the cornea had regained its luster, there were no signs of any filamentary changes and the cornea did not stain with fluorescein. The eye showed no inflammatory changes.

To recapitulate, hyaluronidase is an enzyme that causes hydrolysis of the glucosaminidic bonds of hyaluronic acid. A marked reduction in the viscosity of solutions of hyaluronic acid takes place. The action of the hyaluronidase *in vivo* is purely local and is confined to the intercellular ground substance with which it comes in

contact. No systemic effects or side-reactions attend its use.¹²

Table 2 indicates the results on the intraocular pressure following iontophoresis with hyaluronidase.

From this short series of cases, the following conclusions may be drawn:

- Iontophoresis is an effective method of introducing hyaluronidase into the anterior chamber aqueous.
- A reduction of intraocular pressure takes place within 24 hours after this treatment.

This preliminary report indicates that fur-

ther investigations are required. This method of therapy may be a valuable addition to the armamentarium of the ophthalmologist in the treatment of glaucoma. It is an office procedure that is easily applied.

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SOME CHARACTERISTICS OF VOLUNTARY HUMAN OCULAR MOVEMENTS IN THE HORIZONTAL PLANE*

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INTRODUCTION

Voluntary change of fixation between two stationary targets is carried out by a single rapid movement of the eyes known as a saccadic movement or saccade,⁶ often fol-

lowed by a small secondary corrective movement.^{5,13} Saccadic movements may range in extent from less than a degree¹³ to as much as 90 degrees.⁹ Many descriptions of the characteristics of saccades have appeared in the literature in efforts to elucidate the central and peripheral mechanisms by which the eyes move conjugately when changing fixation. Since the data are not consistent, it is

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not surprising that no definitive theory has emerged.

Most previous investigators have used methods which limit their observations to a single characteristic of saccadic movements. Mean velocity has often been measured;^{6-8, 12, 14} there are studies of the velocity during a particular phase of the movement,^{3, 9} and of the tendency to overshoot or undershoot the target.^{8, 13} Some methods allow reconstruction of the velocity changes during the course of a movement.^{2, 15} Such velocity functions differ when obtained by different methods; the curves obtained by Westheimer¹⁵ resemble modified sine functions, while those of Brockhurst and Lion² are asymmetric. Since hypotheses as to the mechanism of saccadic movements are dependent to some extent on the shape of the velocity function, it becomes important to determine this shape as accurately as possible.

High-speed photography offers a simple method of slowing down and magnifying an ocular movement so that details undetectable on direct visual observation of the subject are revealed. One can obtain a reconstruction of the velocity function in terms of distance travelled per unit time,¹⁰ with approximate values for maximal and for mean velocity. One can also compare the time spent during a saccadic movement with the time spent between successive saccades. It is also possible to detect some of the secondary saccades or corrective movements at the fixation point.

The present study was undertaken to provide information, using motion picture recording, on the velocity of human voluntary saccadic movements. Emphasis was placed on variations of velocity and other features of saccades with different degrees of separation of the fixation targets. In addition an attempt was made to determine the extent of variation among different subjects.

METHODS

Ten normal adults (six female) aged 24 to 41 years served as subjects. All had sufficiently good vision to see the fixation targets

clearly without glasses. Subjects with light irises were preferred, since the position of the center of the pupil was to be used to determine ocular position.

The task of the subjects was to look as rapidly as possible back and forth between a pair of targets, while their ocular movements were filmed. The targets were dark crosses about 0.5-inch wide. Nine targets were spread in a horizontal line on a flat wall at the height of the seated subject's eyes. The central cross, corresponding to the subject's position of forward gaze, was 48 inches from the subject's eyes. The other crosses were symmetrically placed right and left of center in positions corresponding to angles of 15, 30, 60, and 90 degrees in the subject's visual field. (This placed the most peripheral targets 64 inches from the subject.)

A 16 mm. motion picture camera was placed 2.5 ft. in front of the subject slightly below eye level; neither the camera nor the side lights obstructed the subject's view of the fixation targets.

The subject's head was held in a conventional chin and forehead holder, which minimized but did not eliminate head movements. A small forehead marker (black rectangle) was attached, to be used as a reference point in subsequent film analysis, in order to compensate for movements of the head. (Since the marker was not used in filming the first subject, only a rough analysis of the responses of this subject could be made. While the rough results were comparable to those of the other subjects, much of the data presented are based on only nine subjects.)

A short film of the subject's eyes was made while fixating each of the targets in turn. This yielded data for calibrating the position of the pupil corresponding to each direction of gaze, and was necessary because use of the pupil as a land-mark of ocular position may be misleading especially in rotations of large extent. A single pair of targets was exposed, and films of five movements to left and five to right were taken for each series. Recording began with the symmetrical 15

degree targets, then those at center and 30 degrees right, then the symmetrical targets of 30, of 60, and of 90 degrees. A second series was then filmed in the reverse order. Thus films were available of 20 saccades between any two targets for each subject. For the major study the camera speed corresponded to 45 frames per second.

In a subsequent experiment, five months later, the eyes of five of the original subjects were filmed at a speed of 64 frames per second while looking between targets at center and 30 degrees left, at center and 30 degrees right, and 15 degrees left and right of center.

A single-frame projector (Dunning) was used for the major film analysis. Magnification corresponded to five times the original subject. The position of the center of the pupil with reference to a fixed landmark (forehead marker) was plotted for each film frame, yielding a series of pupillary positions for each saccadic sweep. Separate plots were made for each movement of each eye.

Measurements of the distance travelled per film frame interval were used to reconstruct a velocity function. Because of possible subjective error in measuring the center of the pupil, data from a series of saccades were pooled. The greatest distance travelled between any two frames yielded a measure of maximal velocity. The difference in the distance travelled between pairs of successive frames was used for reconstruction of an approximate function of acceleration. The mean velocity of a saccadic movement could be calculated from the number of frames spent in executing a movement of a given distance. A count of frames between successive saccades gave the time spent in the vicinity of the target.

To determine the approximate proportion of trials in which the major saccade was followed by a second short corrective movement, films were run through a variable speed projector at approximately one-eighth the speed of the original movement. When the eyes were seen to stop, then move a short

distance before a second stop, this was counted as a corrective movement.

RESULTS

A. SACCADIC MOVEMENT OF 60 DEGREES

Rapid change of fixation between two targets located 30 degrees left and 30 degrees right of the position of forward gaze is a task well within the limits of normal ocular rotation. Slow projection of the films of the subjects performing this task revealed that most if not all of the distance was covered in a single smooth movement. On leaving one fixation point the eyes increased their speed to a maximum, then began to slow down, approaching the second fixation point relatively slowly. The mean velocity of all subjects averaged 485 degrees per second for 60 degree movements (table 1-A).

A velocity curve was reconstructed from measurement of the distance of pupillary movement from film frame to frame. The curve presented in Figure 1 is the average of measurements of all 60 degree saccades, to left and to right, of both eyes of nine subjects. As the figure shows, from a fixed position the eyes began to move more and more rapidly until they reached a maximal velocity which averaged 680 degrees per second. This high rate of speed was not maintained. As the second fixation point was approached the eyes were moving very slowly. On the average, 49 msec. were spent reaching the maximal velocity (range 42 to 66 msec.), and 93 msec. were spent completing the movement (range 75 to 140 msec.).

Separate reconstruction of the movements of each eye revealed a degree of simultaneity in the movements which was within the limits of the method of film scoring. There was no indication that any of the movements of any subject were not completely conjugate.

Measurements of all 60 degree saccades to left and to right were combined to yield an average velocity function for each of nine subjects. Each subject's curve was positively skewed, showing maximal velocity at approximately the same time after onset of a

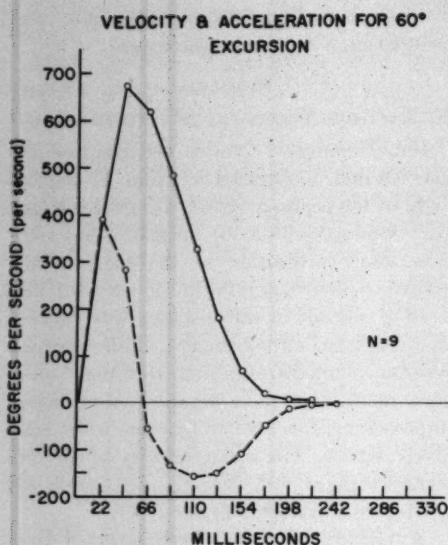


Fig. 1 (Hyde). Velocity (uninterrupted line) and acceleration (dashed line) as functions of time. Human voluntary changes of fixation between targets separated by 60 degrees. Curves averaged from 20 saccades for each of nine subjects.

movement. The major variation was in the final portion of the curves, final slowing being abrupt in two subjects and gradual in the majority.

An approximation of changes in acceleration could be determined from measurements

of the rate of change in velocity between each two film frames. It can be seen from the acceleration curve of Figure 1 (dashed line) that the curve of positive acceleration is sharply peaked, while that of negative acceleration is flatter and smoother. The maximal positive acceleration is at least twice as great as the maximal negative acceleration.

B. SACCADIC MOVEMENTS OF DIFFERENT DISTANCES

The changes in velocity of saccadic movements as a function of distance are summarized in Figures 2 to 5 and Table 1. For all subjects the speed of the ocular movement was so similar that the data from all subjects were combined for the figures. The curve for each angular distance presented in Figures 2 and 3 is based on the average of 10 movements to the left and 10 to the right measured separately for each eye of nine subjects. The extent of subject variation is presented in Table 1.

Reconstruction of the time course of ocular movement (fig. 2) reveals that for each distance a maximal ocular velocity was reached rapidly. This rate of movement was not maintained for movements of 30 degrees or more; the eyes began to slow at once. As the interfixation distance was increased, deceleration occupied a greater proportion of

TABLE 1
VELOCITY (DEGREES PER SECOND) OF HUMAN SACCADIC MOVEMENTS AS A FUNCTION
OF HORIZONTAL DISTANCE
(N = 9)

A. Mean Velocity		Mean Velocity		Range	
Extent of Movement		Mean	Sigma	Slowest	Fastest
15°		335	39.14	290	355
30°		425	43.22	275	510
60°		485	55.07	370	570
90°		475	43.33	410	540

B. Maximal Velocity		Maximal Velocity		Range	
Extent of Movement		Mean	Sigma	Slowest	Fastest
15°		324	26.19	260	350
30°		529	60.16	450	600
60°		683	72.79	570	800
90°		727	59.18	670	830

the total time of the saccade (fig. 5); this is reflected in the increased skewness of the velocity curves for the larger distances (fig. 2).

The maximal or peak velocity showed an increase with increasing interfixation distances from 15 to 90 degrees (fig. 4) although the relative increase was greater between the smaller distances, the curve tending to flatten at the upper end. The average time spent executing a saccadic movement increased almost linearly with the distance of the movement (fig. 5, total travel time). The mean velocity therefore increased relatively little with increasing distance, and in fact was less at the 90 degree distance than at 60 degrees (fig. 4).

The curves of negative acceleration (fig. 3) suggest a relatively rapid braking action of the extraocular muscles in stopping the 15 and 30 degrees movements, and a slower, smoother deceleration for the longer excursions. For each distance studied, the final part of the curves suggests a slow "creeping" to the target (also fig. 2). This was more pronounced in the individual curves of some subjects than of others. Within the limits of

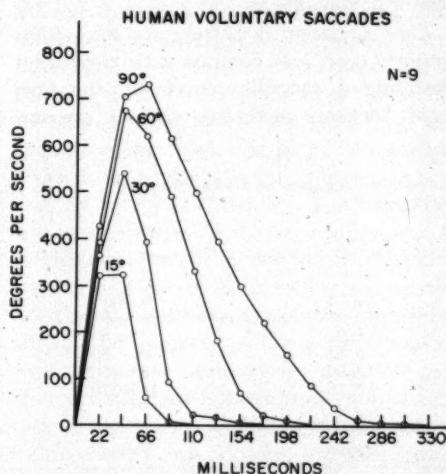


Fig. 2 (Hyde). Velocity of ocular movement during voluntary change of fixation as a function of time. Targets symmetrically located 15 to 90 degrees apart. Each curve averaged from 20 saccades for each of nine subjects.

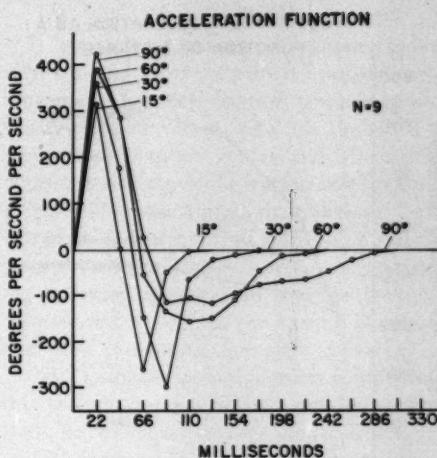


Fig. 3 (Hyde). Acceleration and deceleration during human saccadic movements of 15 to 90 degrees.

the method used to derive an acceleration function, there seems little increase in maximal acceleration as a function of distance in contrast to the increase in maximal velocity (fig. 4).

The relative speed of the eyes as they moved past the primary position could be determined from a reconstruction of the percent distance travelled as a function of time. For movements of 15 to 60 degrees, the eyes were moving at maximal velocity when they were within four degrees of the primary position. For 15 and 30 degree movements the eyes were still accelerating as they passed the primary position; for larger excursions they had already begun to decelerate. This was most pronounced for the 90 degree distance; the maximal velocity of 90 degree saccades corresponded to a position 14 degrees short of the primary position.

Velocity of movements to left and to right. The velocities of saccadic movements from left to right were compared with those from right to left for the 30, 60, and 90 degree trials of each subject. Two subjects moved their eyes equally fast in each direction for all three distances. In three subjects, movement was faster to the left for one distance, faster to the right for another, and equal for

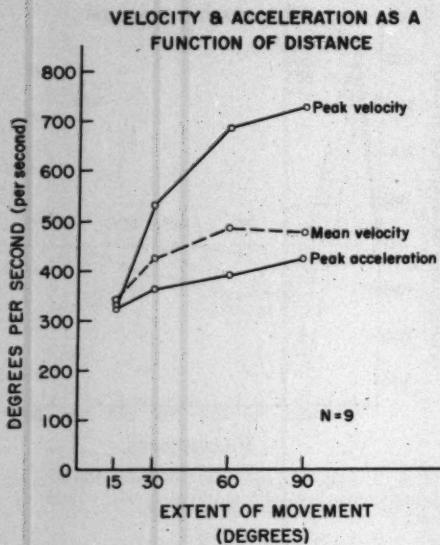


Fig. 4 (Hyde). Average values for saccadic movements of nine subjects: maximal and mean velocity and maximal acceleration at each of four intertarget distances.

the third. In four subjects, movement to the right was faster at one or more distances and was never faster to the left. In total, with nine subjects and three distances, velocities were equal for the two directions in 13 cases, were faster to the right in 11 cases, and were faster to the left in only three cases. Where there were directional differences in maximal

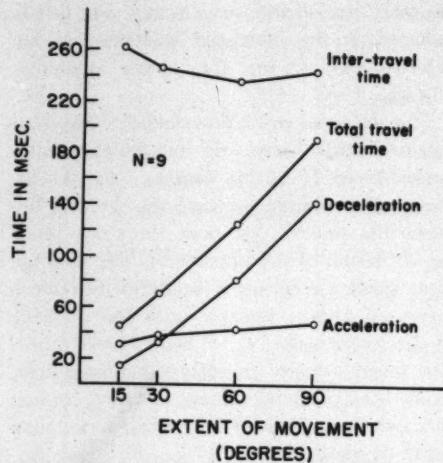


Fig. 5 (Hyde). Variations in proportion of time spent in different portions of saccadic movements as a function of intertarget distance. Time of acceleration plus time of deceleration equals total travel time. Time between successive saccades equals "intertravel" time. Data average from nine subjects.

velocity, they were of the magnitude of 50 to 100 degrees per second. There was no consistent relation between faster ocular velocity in one direction and either handedness or dominant eye.

Time between successive saccades ("intertravel time"). In contrast to the time spent executing a saccadic movement, the time spent between successive saccadic sweeps

TABLE 2
TIME SPENT IN A SACCADIC MOVEMENT AND BETWEEN SACCADES AS A FUNCTION OF HORIZONTAL DISTANCE
(N=9)

A. Duration of a saccade in msec.

Extent of Movement	Mean Time	Sigma	Range
15°	45 msec.	5.07	35-50
30°	71	6.83	60-80
60°	125	15.60	105-160
90°	190	17.16	165-220

B. Time at or near fixation point between successive saccades, in msec.

Extent of Movement	Mean Time	Sigma	Range
15°	262 msec.	47.97	180-335
30°	245	43.29	155-305
60°	235	41.73	175-325
90°	243	67.86	170-360

showed no increase with increasing separation of the fixation targets (fig. 5). The "intertravel time" was the function which showed the greatest variation between subjects (table 2-B). In six subjects, the "intertravel time" was relatively constant regardless of the distance between fixation targets; for three subjects this time tended to decrease as the distance was increased. Although all subjects tried to move their eyes as rapidly as possible between any pair of targets, they were unable to increase their ocular velocity even with practice. One subject made an effort to increase his speed half way through the experiment; the result was a slight decrease in "intertravel time" but no change in the velocity of the saccade itself.

Corrective movements. Corrective movements (small secondary saccadic jerks near the fixation point) could be detected in 37 percent of all trials. There was no correlation between the proportion of trials with corrective movements and the "intertravel time," either within the responses of one subject or between subjects, for any of the symmetrical distances tested.

If a corrective movement was in the same direction as the original saccade, it was considered correction for "undershooting" the target; if the direction was reversed, it was considered correction for "overshooting." In seven percent of all trials the eyes "overshot" the fixation point, and in 30 percent there was correction for "undershooting." As seen in Table 3, the tendency in the shorter distances was to "overshoot" while "undershooting" was more evident for the larger distances.

There was no correlation between the proportion of trials with corrective movements and the maximal velocity of a saccadic sweep among the subjects. Although the subject with the fastest mean velocity at 30, 60, and 90 degrees had the highest proportion of corrective movements, and the subject whose mean velocity was slowest had the fewest corrections, the other subjects showed no correlation between mean velocity and proportion of corrective movements.

C. ASYMMETRIC MOVEMENTS

It was felt of interest to compare movements to and from the primary position with movements between fixation points symmetrically located either side of center. For movements between center and 30 degrees right, the velocity of the movements to center ("inward") was higher than that of "outward" movements for all subjects. From the primary position, the eyes slowly began moving laterally, reaching an average maximal velocity of 510 degrees per second. Deceleration was prolonged, the eyes appearing to "creep" to the peripheral fixation point. From this target, the eyes started rapidly moving back, achieving an average maximal velocity of 580 degrees per second. Deceleration was rapid, the eyes appearing to stop abruptly. The proportion of the total movements of all subjects which had corrective movements at the primary position was higher (37 percent) than those at the peripheral target (28 percent). Only two of 10 subjects had a higher percentage of trials with corrective movements at the periphery than at the center.

The average velocity curve for 30 degree symmetrical movements was found to be intermediate between that of inward and that of outward movements of the same extent. The proportion of corrective movements on symmetrical movements (38 percent) was approximately that found with movements to the primary position.

Because in three subjects the velocity of symmetrical movements to the left was faster than to the right,¹¹ further experiments were made on five of the original subjects to see whether inward movements would be faster

TABLE 3
PERCENT OF SACCADIC SWEEPS OF DIFFERENT DISTANCES FOLLOWED BY CORRECTIVE MOVEMENTS
(N = 9)

Distance	15°	30°	60°	90°
Overshoots	12%	9%	8%	0
Undershoots	10%	28%	45%	36%
TOTAL	22%	38%	53%	36%

TABLE 4
SYMMETRICAL AND ASYMMETRICAL SACCADES OF 30 DEGREES
(N = 5)

	Mean Velocity Degrees per Second		Av. Max. Velocity (deg./sec.)	% Trials with Corrective Movements	Mean "Inter- travel Time" (in msec.)
	Average	(range)			
Inward					
Right to 0	449	(392-493)	586	29.3%	262
Left to 0	420	(337-506)	557	38.1%	277
Combined	435			33.7	270
Outward					
0 to left	373	(343-409)	477	22.4	297
0 to right	382	(343-437)	482	26.8	332
Combined	377			24.6	315
Symmetrical					
R. to l.	437	(409-481)	541	40.5	280
Left to r.	400	(343-469)	548	31.0	304
Combined	419			35.8	292

than outward regardless of whether the peripheral target was located to left or to right of center. Even on those subjects whose velocity was consistently higher on symmetrical movements from right to left, the movements from 30 degrees left to center were consistently faster than those from the primary position to the left. As seen in Table 4, the proportion of trials with corrective movements at the primary position was higher than those 30 degrees left or right, although not quite so high as at 15 degrees left or right of center (symmetrical movements).

DISCUSSION

Since Lamansky¹² first estimated the velocity of saccadic movements with the ingenious use of after-images, the development of photographic and electronic methods of recording has induced many investigators to study the speed of ocular movements. Some techniques measure the length of time taken by the eye in rotating through a given distance, from which one can calculate the mean velocity. Dodge,⁶ Travis,¹⁴ and Gerathewohl and Strughold⁸ confirmed Lamansky's observation that the mean velocity progressively increases as the distance of the interfixation points is increased. The actual values for mean velocity found by Dodge⁶ for movements of five to 30 degrees, and by Travis¹⁴

for movements of five to 15 degrees, are close to those found in the present study for 15 and 30 degrees. Gerathewohl and Strughold⁸ found somewhat lower mean velocities. Lamansky's¹² study yielded values much higher than those found by any other method.

Bruckner⁸ determined the distance travelled in the first $\frac{1}{49}$ second of a saccadic movement to obtain a measure of initial velocity. He reported that movements to the primary position started more slowly than movements from this position. This observation has not been confirmed; Dodge and Cline⁷ and more recently Brockhurst and Lion² as well as the present study all agree that movements to the primary position are faster than outward ones. With respect to symmetrical movements to left and to right, Dodge and Cline⁷ reported that movements to the left tended to be faster than those to the right. In contrast Travis¹⁴ found that on the average with a large number of subjects movements tended to be faster to the right. In the present study there were individual variations in directional velocities¹¹ although there were more examples of faster movements to the right than to the left.

Several methods have been used to reconstruct the changes in speed of rotation during a saccadic movement. Guillery⁹ studied the after-image pattern formed by sweeping his

eyes through a 90 degree arc past an intermittent light, and found that the velocity was not constant, but was maximal near the middle of the path. Westheimer¹⁵ constructed a velocity function from his records of positional changes obtained with a modified ophthalmograph. From his reconstruction of the velocity function of a typical 20 degree saccade, the times of acceleration and of deceleration are equal; a modified sine curve results. This curve does not resemble those which Brockhurst and Lion² obtained by electronic derivation of the velocity from the positional records; the latter authors obtained asymmetrical velocity functions very similar to those of the present study. In spite of dissimilarities, all these velocity functions have in common the finding that the velocity changes throughout the course of a saccadic movement; none of them confirm Adler's statement¹ that the eye "moves with fairly even speed." Rather the major evidence is supported by Adler's excellent description of why, on the basis of muscle mechanics, we could expect the eye to move quickly at first and more slowly afterward.

Westheimer¹⁵ suggested the hypothesis that "a saccadic movement is initiated as a single, unitary step by means of simultaneous changes in innervation to each of the eye muscles involved. This produces a change in the tension of the various muscles, which may be considered to be affected extremely rapidly. The eyeball then assumes a new position in the orbit which is dictated by the net torque produced by the changes in muscle tension and the forces opposing it—friction, inertia, and elasticity." The present study seems to offer evidence that Westheimer's explanation of the mechanism of a saccadic movement is not completely satisfactory at least for large movements. If one agrees that opposing forces should be minimal in the primary position, then it is difficult to see why the velocity should not be maximal as the eyes pass this position, if Westheimer's hypothesis is correct. Yet with the 90 degree saccades, the eyes begin to slow down after rotating through only one third of the distance,

and while still 14 degrees short of the position of forward gaze.

Saccadic movements differ in several respects from the slower pursuit or following movements of the eyes in response to a moving target.¹⁶ Evidence from studies of reading indicates that there is no perception during the saccadic jerks which move the eyes from one fixation point to the next.⁴ However, some evidence from the present study suggests the possibility that perception, to the extent of recognizing a peripherally located target, may be possible even before the eyes have come to a complete stop after a saccadic sweep of large extent. With the 90 degree saccades, the film analysis indicated a gradual "creeping up" to the target; a large proportion of such movements were apparently accurate since no corrective movements were observed in two thirds of the trials. Similarly in comparing inward and outward movements, the eyes moved toward the primary position rapidly, stopped abruptly at or near this position, and were often seen to make a secondary corrective saccade to fixate the central target; when moving peripherally, the velocity was slower, and indeed gave the eyes the appearance of "creeping" onto the target; fewer corrective movements were noted than at the central fixation target. Where a change of fixation is not followed by a secondary corrective movement it must be assumed that the initial large saccade has brought the eyes accurately to the target. Even Sundberg¹⁸ and Clark⁵ with their more precise methods for detection of corrective movements did not find such corrections in all trials. When the two fixation targets are separated by 15 degrees or less, the second target can be seen peripherally while the first is being fixated; such advance localization may explain the low proportion of corrective movements after a saccade through this distance, and the progressive increase of corrective movements found by Clark⁵ when increasing the intertarget distance from nine to 25 degrees.

SUMMARY

Saccadic eye movements during voluntary

changes of fixation have been studied in 10 subjects.

In a saccadic movement from one fixation target to another the eyes rapidly accelerate to a maximal velocity and immediately begin to slow down. When the fixation targets are separated by 60 or 90 degrees, deceleration is so prolonged that the resulting velocity curve is highly skewed. This asymmetry is less pronounced but still present with movements through 15 or 30 degrees.

The maximal velocity increases with increasing distance to a much greater extent than either the maximal acceleration or the mean velocity.

While the shape of the velocity function for any distance was very similar for all subjects, there was much variation in the length of time between successive saccades. For six subjects this time was independent of the distance separating the fixation targets; for three, it decreased with increasing distance.

The proportion of trials in which small secondary saccades or corrective movements were noted was greater for 60 degree excursions than for larger or smaller distances. With small distances the eyes tended to "overshoot" the target, while "undershooting" was more evident at the larger distances.

There was no correlation between the proportion of trials with corrective movements and the length of time between successive large saccades. There seemed some correlation between a larger proportion of trials with corrective movements and an abrupt "braking" at the end of the main saccade.

Velocity curves of asymmetrical movements of 30 degrees showed that "inward" movements, to the primary position, are faster than "outward" ones, and that the eyes appear to move rapidly toward the center and stop abruptly, while deceleration is more gradual when moving peripherally. The number of corrective movements at the primary position was higher than at the peripheral target.

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NOTES, CASES, INSTRUMENTS

RETROBULBAR NEURITIS IN PERNICIOUS ANEMIA*

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That an involvement of the optic nerve resembling retrobulbar neuritis may occur in patients with pernicious anemia is a fact not apparently well known by most American ophthalmologists. Mention is made of this occurrence in a few current textbooks,¹⁻⁴ but to our knowledge no detailed case reports have appeared in the American ophthalmologic journals. Instead these scattered reports have, in this country, appeared only in the internal medicine and neurologic publications.⁵⁻¹⁰ Since the presenting symptoms of patients suffering from pernicious anemia may be chiefly ocular, it seemed worth while to report a case seen by us and previously recorded in our review of the literature on this subject.¹¹ The medical aspects of this case were described in that article.

We were able to find reference to only 45 cases of optic-nerve involvement in pernicious anemia and of these cases only 29 had any details given. The criteria for a diagnosis of pernicious anemia were in many of the 29 cases quite insufficient by our modern standards but were substantial enough for us to accept as representing true cases of pernicious anemia. The important fact from an ophthalmologist's standpoint was that in nine of these 29 cases the eye findings antedated all other manifestations; and in an additional six cases, the eye symptoms were concomitant with neurologic symptoms of subacute combined sclerosis.

CASE REPORT

History. A 47-year-old white man was seen in the out-patient department of the Department of Ophthalmology, University Hospitals, in July, 1952. His complaint was that his vision had failed in both eyes for the past eight months. He had his glasses changed without any benefit. In the past couple of months he became aware of a blindspot in his left eye.

In addition to these eye symptoms the patient had noticed tingling and numbness of his fingers and cramps in his legs for the past few months. He had become irritable during this period of time.

Six years prior to this time he had been told he was anemic and told to add cooked liver to his diet and to take a dilute hydrochloric acid preparation with each meal. He did not follow these instructions very closely.

Despite the fact the patient was not a heavy smoker, a diagnosis of tobacco amblyopia had been made by the ophthalmologist who originally saw this patient. The patient had been advised to give up smoking but he refused to do so. He had been treated with one gm. of sodium nitrite, three times daily, and typhoid antigen without any benefit by a second consultant who had diagnosed a central retinitis.

There was no history of the use of alcohol. There was no known exposure to toxins, and the patient had not received any medications or drugs other than those already mentioned.

Ophthalmologic examination. The vision in the right eye was reduced to 6/6 - 3 and in the left eye to 6/30. The visual field in the left eye showed a paracentral scotoma that included the fixation point but not the blindspot (fig. 1). The ophthalmoscopic examination was normal as was the remainder of the eye examination.

General physical and laboratory findings. There was some atrophy of the papillae of the tongue margins. Parasthenia was reduced to less than one-third of normal. The biceps, knee jerks, and tendon Achilles jerks were hypoactive.

The hemoglobin was 12.4 gm per 100 cc. The red blood cells were 3.8 million per mm. The reticulocyte count was 0.6 percent. The peripheral smear of blood appeared normal; bone-marrow smears showed erythroid hyperplasia with minimal megaloblastic changes. Achlorhydria was present after intramuscular histamine was given.

Course. The patient was started on injections of intramuscular vitamin B₁₂. At the end of four days a repeat bone-marrow smear showed an increase in the more mature normoblasts. The patient was discharged to the care of his family physician who continued frequent injections of vitamin B₁₂. During the next few months the central vision steadily improved. The numbness in his arms disappeared, and his personality improved. The red blood count

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rose to about 4.5 million and the hemoglobin to about 13.8 gm; they remained at these levels thereafter.

Follow-up. The patient was again seen in September, 1957. He was free of complaints. The vision in the right eye was 6/6 and in the left eye 6/9. The visual fields were normal. There were no positive neurologic findings. The blood picture was essentially normal.

A Shilling test was performed during this visit. Of the 0.5 μ c. of cobalt⁶⁰-labelled vitamin B₁₂ given orally, only 0.7 percent was recovered in the urine in 24 hours. This low value indicated an absence of the intrinsic factor.

COMMENT

This case has many interesting features. It also caused us to speculate upon some other possibilities.

The fact that this man had a blood picture which by routine blood count was not diagnostic of pernicious anemia should serve to remind us that neurologic involvement can occur in pernicious anemia even though the count is not remarkably low. The likelihood of an increasing incidence of this type of finding might be a distinct possibility. Folic acid is now commonly included in multi-vitamin preparations. This substance, though acting to stimulate red blood cell development, does not act to prevent neurologic complications of pernicious anemia. In fact folic acid is actually thought by some work-

ers to accelerate neurologic involvement. Therefore, in patients who have been on a preparation containing folic acid and who have or develop pernicious anemia, the diagnosis of pernicious anemia cannot be made by hematologic studies alone. Neurologic findings, which could include optic nerve involvement, could be attributed to pernicious anemia only if special studies such as the Shilling test were performed.

In the past, the incidence of optic nerve involvement in pernicious anemia has been considered to be quite low. Optic atrophy in pernicious anemia and subacute combined degeneration have been reported to occur in from one half to nearly two percent of the cases. No exact figures are available for the incidence of retrobulbar neuritis in patients with pernicious anemia who do not have cord lesions. Likewise, no figures are available for the number of patients who develop an optic neuritis which does not progress to an optic atrophy.

It is probable that the pathologic process in the optic nerve is similar to the subacute combined sclerosis that occurs in the lateral and posterior columns. This is merely speculative, since autopsy and histologic materials are lacking.

The eye findings of decreased visual acuity, a normal-appearing disc, and a central scotoma appear to be quite typical in patients with early optic-nerve involvement associated with pernicious anemia. Therefore, the diagnosis of such patients would seem to be that of any case of retrobulbar neuritis. Demyelinating diseases, toxins, drugs, orbital inflammations, and inflammations of adjacent structures, such as the ethmoids, should be considered. Neurologic examination, history of drugs, or exposure to toxins, X-ray studies, hematologic examination, and gastric analysis should all help to make the differential diagnosis.

It seems apparent from our review of the literature and from this reported case that the prognosis for normal vision is good if adequate treatment is initiated early. The

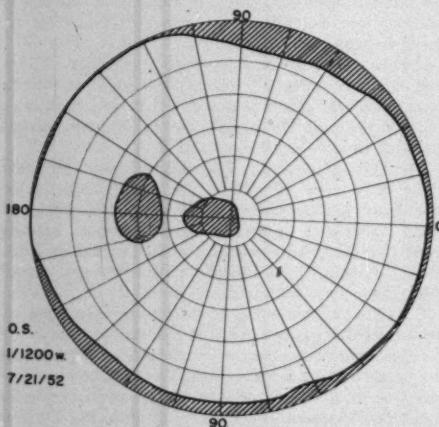


Fig. 1 (Ellis and Hamilton). Central field, showing a paracentral scotoma of the left eye.

response of the optic nerve lesion is similar to other neurologic lesions in this respect. Delayed or inadequate treatment may result in optic atrophy and permanent visual loss.

Since, as already mentioned, the eye symptoms may be the initial presenting symptoms, and since with adequate treatment a cure can

be effected, we felt that the attention of the ophthalmologist should be called to this interesting finding of a retrobulbar neuritis in pernicious anemia.

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SUPERFICIAL PUNCTATE KERATITIS*

IN ASSOCIATION WITH OCULOMOTOR AND
TROCHLEAR NERVE PALSY

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Calcutta, India

Superficial punctate keratitis, as it involves the central and superficial zone of cornea, etiologically stands as a mere clinical condition and denotes nothing specific. As cited by Duke-Elder (1938), it could be presented in a herpeslike virus infection, a simple herpetic keratitis before dendritic ulcer develops, toxins affecting the gasserian ganglion resulting in neurotrophic disturbances of the cornea, occasionally in neuro-paralytic keratitis, after parasitic or bacterial infection, and in cases of nutritional disturbance.

As regards seasonal prevalence, superficial punctate keratitis of viral origin is quite common in this part of the country during July and August immediately after the monsoon is over. Incidence during the winter months is rather unusual here but its occurrence in European countries during that period is increased, as reported in the textbooks.

While discussing herpes zoster ophthalmicus, Walsh (1957) mentions the occurrence of ophthalmoplegia. It is incomplete and comes when vesicular eruptions on the skin start scarring. The virus affects the ophthalmic division of the trigeminal nerve at first and then spreads to other ocular motor nerves. Of these nerves, affection of the third cranial nerve is the most common, which is again always incomplete. Trochlear palsy is comparatively very rare (Hunt 1909, Metz 1913, Edgerton 1945 [as referred to by Duke-Elder 1949]). Edgerton (1945) also observed that ophthalmoplegia could recur either after or even before skin eruptions. But none of these authors mentions

* From the Department of Ophthalmology, Sambhu Nath Pandit Hospital. Presented at the clinical meeting of the Ophthalmological Society of Bengal on May 29, 1958.



Fig. 1 (Agarwala). There was complete ptosis of the left eye with no elevation of the eyelid.

any relation between a corneal lesion and ocular motor palsy. In the case presented here, motor palsy first appeared and the peripheral corneal lesion a week later.

Duke-Elder (1949) mentions that prognosis is good in ophthalmoplegia of herpetic origin and the average time for recovery is six weeks. Carmody (1937) observed remission in two to three months' time.

CASE REPORT

A married Hindu Bengali woman, aged 55 years, came on November 21, 1957, with the complaint of drooping of the left upper lid since November 14th. The eye was completely closed by two days' time; pain and redness of left eye had been present for the last 24 hours.

Examination. Left eye. Upper lid: Complete ptosis. No elevation of lid was possible (fig. 1). The eye was deviated outward, when the other eye was in the primary position (fig. 2). Except for abduction, other movements were completely absent. In the conjunctiva, there was both peripheral and circumcorneal congestion of the blood vessels, a very slight mucoid discharge, and profuse lacrimation.

The cornea showed grayish-white infiltrates of various sizes and forms, involving the superficial strata. They were present over the central area (fig. 3). Very few of them took a faint stain with fluorescein. The sensitivity was diminished.

The iris was slightly muddy. The pupil, smaller than that of the right eye. Reaction to light not elicited. The left pupil dilated to some extent with homatropine (one percent). Digital tension was normal.

It was not possible to examine the fundus at this time. Vision was hand movements only.

Right eye. This eye was normal in all respects, except the lens showed an immature senile nuclear-

type cataract. Vision was 6/24.

General examination did not reveal any other abnormality except slight nasal catarrh. Blood pressure was 130/85 mm. Hg. X-ray films of the skull were normal. Serologic test for syphilis, negative; urine reaction acid, sp. gr., 1010; sugar and albumin, nil. Blood R.B.C., 3,500,000/cmm., W.B.C. 7,600/cmm., hemoglobin, 65 percent, poly 54 percent, lymphs 41 percent, monos, 3 percent, eosin, 2 percent. No parasites.

Follow-up. Sulfacetamide (10 percent) was prescribed for her local condition, homatropine (one percent drops), and chloramphenicol eye ointment (one percent), with the result, the eye became quiet and the cornea became clear and transparent on November 30th.

The patient was also given systemically vitamin B complex and vitamin C (by mouth) and vitamin B₁ (per intramuscular injection) in heavy dose. On January 16, 1958, though ptosis was present and the eye was still in an abducted position as before, intorsion movement of the globe was first recorded while attempting to look downward. By January 23rd ptosis was completely cured and her eye was straight (fig. 4) and could move normally in all directions. There was no misdirection phenomenon in connection with regeneration of the oculomotor nerve.

The vision in her left eye improved to 6/36 only,



Fig. 2 (Agarwala). The left eye deviated outward when the right eye was in the primary position.

as the lens in this eye also revealed the same type of cataract as in the other eye. The fundus was normal.

COMMENT

This case undoubtedly is a neurotrophic virus infection. Pain, iritis, incomplete ophthalmoplegia, and the corneal lesion as described suggest the virus to be herpes zoster ophthalmicus. Cure of the muscle palsy in 10 weeks also favors this supposition. But absence of a skin eruption and quick recovery of the cornea while the disease was still persisting are very peculiar and unusual.

Sulfacetamide drops and/or chloramphenicol ointment locally in the cornea might have some beneficial action against this virus or viral toxins.

The onset at an unusual time of the year and so complicated a clinical picture nullify the premise that this was a superficial punctate keratitis of common origin. As such the case is atypical from both points of view.

Contraction of the pupil in the initial stage of the disease may have been due to iritis but its dilatation with homatropine definitely suggests the sparing of the pupillary fibers in the third cranial nerve. This makes the oculomotor palsy an incomplete one. Walsh (1957) mentions such a rare phenomenon and remarks that the day is near when definite areas through which pupilloconstrictor fibers travel along the oculomotor nerve will be revealed.



Fig. 3 (Agarwala). The superficial strata of the cornea showed grayish-white infiltrates.



Fig. 4 (Agarwala). Appearance of the patient after treatment, showing the ptosis cured and the left eye straight.

Walsh (1957) also mentions that paralysis of the trochlear nerve is always associated with either the oculomotor or the abducens, or with both nerves, and the site of the lesion is either in the cavernous sinus or in the orbit. In my case, considering the picture as a whole, the site of the lesion was more likely in the cavernous sinus. Partial involvement of the nasociliary nerve also, with the miraculous absence of a vesicular eruption even at the tip of the nose, and the escape of the other two branches of the ophthalmic division of the trigeminal nerve remain unexplained.

According to Walsh (1957), when third nerve palsy is inflammatory in origin, its recovery is less frequently associated with a regeneration syndrome. Fortunately, regeneration was complete in my patient and took place in a normal way among different sets of fibers in the oculomotor nerve.

SUMMARY

An atypical case of superficial punctate keratitis associated with a peripheral oculomotor nerve lesion, with escape of the

pupilloconstrictor fibers and trochlear palsy, is reported. Complete recovery of the cornea took place in 10 days, and that of ophthalmoplegia in 10 weeks.

3, Dwarka Nath Tagore Lane (7).

ACKNOWLEDGMENT

My thanks are due Dr. N. Das, surgeon-superintendent, Sambhu Nath Pandit Hospital, and to Dr. M. Sen Gupta, assistant professor of ophthalmology, Eye Infirmary, Medical College Hospitals, Calcutta.

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A METHOD OF PERIPHERAL FUNDUS EXAMINATION

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Any technique simplifying the examination of the fundus periphery is desirable. The following procedure, which utilizes the use of the Goldmann gonioscopy lens (three-mirror lens preferred) combined with an accessory lens and an ophthalmoscope, has proven to be valuable in my hands.

Direct peripheral fundus ophthalmoscopy through the flat face of the Goldmann lens is unsatisfactory because the absence of corneal dioptric power makes it necessary for the viewer to use in the ophthalmoscope aperture a high-plus power to compensate for the dioptric deficiency. Even when this is done, the beam of light from the ophthalmoscope enters and is transmitted through the eye to the retina in a parallel, unfocused cylinder of light, leaving the retina inadequately illuminated (fig. 1). With an accessory lens the corneal dioptric refractive power is compensated for, and the ophthalmoscope beam of light is focused onto the retina allowing "normal" illumination (fig. 2).

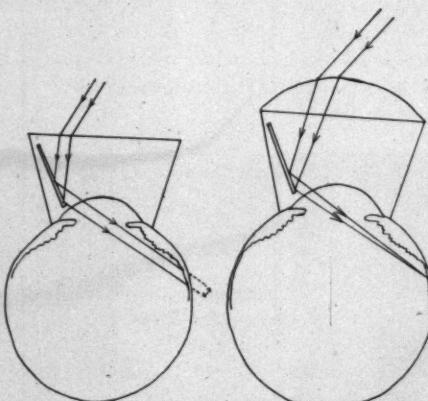
The accessory lens is a planoconvex, of 20 diopters, having the same diameter as the contact lens face (28 mm. for the three-mirror Goldmann lens).

The contact lens is inserted with the pa-

tient in the recumbent position, as in Koeppe lens gonioscopy, and the standard methyl cellulose solution is instilled. A small drop of plain water is placed on the contact lens and the accessory 20D. lens is placed on the surface of the contact lens. Ophthalmoscopic examination is then carried out.

The advantages of this method are: (1) the usual instrumentarium of the average ophthalmologist is utilized; (2) structures are visualized in the customary proportions of ophthalmoscopy; (3) simplicity.

The three-mirror gonioscope is preferable to the single lens because, during the exami-



Figs. 1 and 2 (Emerson). (fig. 1, left) Inadequate illumination of retina. (fig. 2, right) The ophthalmoscope beam of light is focused onto the retina, allowing "normal" illumination.

nation, both the gonioscopy and intermediate mirrors may be scrutinized before the lens is rotated to study the next sector, thus allowing a wider "anteroposterior" sweep.

I prefer to use water on the face of the contact lens because methyl cellulose solution, with its lubricant properties, allows the superpositioned accessory lens to slide about too easily. A small drop of water permits the continuity of the media, and the capillary action at the interface permits little undesired mobility. The accessory lens may be pressed upon to squeeze out excess water, thus better producing a capillary interface film.

235 Alexander Street (7).

WHITE SPOTS OF THE FUNDUS

COMBINED WITH NIGHT BLINDNESS AND XEROSIS (UYEMURA'S SYNDROME)

ADALBERT FUCHS, M.D.

Meran, Italy

Uyemura¹ (1928) published two cases of "peculiar fundus changes in cases of idiopathic hemeralopia."*

Two Japanese boys, one aged 14 years, the other, aged 10 years, had Bitot's spots and night blindness for some time. The fundi had a delicate grayish-white appearance and were densely covered by innumerable yellowish-white spots. In the first case these spots were most numerous on the equator, in the second case the spots were mostly present in the periphery. Vision and visual fields were normal just as the papillae and the retinal vessels. Dark adaptation was considerably diminished. After medication with cod-liver oil, the dark adaptation became much better in the first case and after 24 days the white points of the fundus became

gradually less distinct and on the 57th day they had vanished. The second case could not be followed.

I² had seen a similar case in Peking in 1928.

CASE REPORT

On April 8, 1924, a boy 17 years of age, came to the out-patient department, complaining that he had night blindness for 10 months. Night blindness had started then quite suddenly when he walked outside the city and he was not able to see the light of his lantern which he carried in his hand; he had difficulties to find his home. The next day his vision was somewhat better and he was again able to work until the evening. In his room he could see during the evening only when bright illumination was present and he had great difficulty in working with his knitting machine. During the next three months his condition became better without any treatment; however, he was not cured. During February, the patient had a month's vacation and, when he returned and started to work again, he realized that his vision had become worse; since then his vision grew worse every day. No children's disease was reported and the family of the patient was of good health.

Present status. A relatively strong boy of pale complexion does not show any pathologic signs beside small specks of xerosis at the limbus in both eyes on the temporal side.

Ophthalmoscopic examination. Both papillae are normal. At some distance from the papillae both fundi are sprinkled by small whitish specks. These specks are partly round, partly oval, some perhaps somewhat polygonal. They are situated beneath the retinal vessels and are hardly broader than the vessels in the periphery. These specks are most frequent in the equatorial region, around the papillae are none, in the outmost periphery they are less than at the equator. Vision, O.U., 6/75, visual field normal. Wassermann, negative; general examination reveals no pathologic finding.

April 12th. The patient gets daily 100 gm. liver in different kinds of food and cod liver oil. For two days both eyes were bandaged. The vision in darkness was three times better than before and vision increased to 6/6.

April 15th. Diet with liver was continued, xerosis had disappeared; vision, 6/4 in both eyes; the light sense was normal. The fundus showed the same picture and the patient was very happy when he was discharged. He did not return, apparently his complaints did not come back.

DISCUSSION

When the patient was sent to me I discarded from the beginning the diagnosis of retinitis punctata albescens because xerosis of the conjunctiva and the normal appear-

* The word "hemeralopia" means on the European continent and Japan "night blindness," while in England and in the United States it means "day blindness."

ance of the papillae were against it. My expectation that under adequate diet the night blindness would disappear was fulfilled in a short time. Unfortunately, I was not able to follow the case. I had the impression, however, that the fundus changes had nothing to do with the night blindness (1) because night blindness had appeared 10 months earlier and again at the time of examination during spring (at the time when idiopathic night blindness as a rule is observed); (2) because I thought that such a severe visual disturbance would probably be due to a more diffuse disease of the fundi.

The observations of Uyemura that the specks of one case later on disappeared, make it very likely that the specks have something to do with the night blindness. Possibly they accompany night blindness, just as xerosis of the conjunctiva is generally seen. When I had seen these white spots I imagined that possibly congenital defects of the pigment epithelium were present.

This case is not only interesting on account of the white specks in the fundus but also on account of the sudden and grave onset of night blindness.

Professor Uyemura sent me lately a list

of 20 similar cases which had been observed in Japan since 1928 (table 1).

We learn from Table 1 that all 23 observed cases were in children or young people from four to 18 years, eight of them under 10 years of age; only two were girls. Different from the history of my Chinese case, night blindness which had brought the children to the doctors had been present only for a short time (five days to one month). Only one case had had night blindness for about one year, similar to my patient who complained of it for 10 months. The treatment with cod liver oil (as a rule 11 to 15 gr. a day) brought a quick recovery in most of the cases, as Bitot's spots, xerosis, and the white spots of the fundus disappeared together with the night blindness. Only in three cases was recovery not observed but it was not mentioned how long the patients were treated.

"White spots of the fundus" make a very conspicuous ophthalmoscopic picture and can hardly be overlooked. It is astonishing that, apparently, neither in China nor in India was another case observed. I asked many colleagues in China (1946-47) about this syndrome. In these two countries xerophthalmia

TABLE 1
WHITE SPOTS OF THE FUNDUS WITH XEROSIS AND NIGHT BLINDNESS (UYEMURA'S SYNDROME)

No.	Age (yr.)	Sex	Bitot's spots	Xerosis	Disappearance of Spots	Therapy Cod-liver Oil (daily, gm.)	Onset of Nightblindness
1	14	♂	(+)	(+)	After treatment	5-15	2 mo.
2	4	♂	(+)	(+)	After treatment	5-8	1 wk.
3	8	♂	(+)	(+)	After treatment	5-10	5 da.
4	15	♂	(+)	(+)	After treatment	5-15	2 wk.
5	4	♂	(+)	(+)	After treatment	5-10	2 wk.
6	12	♀	(+)	(+)	After treatment	5-15	5 da.
7	10	♂	(+)	(+)	After treatment	5-10	10 da.
8	9	♂	(+)	(+)	After treatment	5-10	1 wk.
9	10	♂	(+)	(+)	After treatment	5-10	1 mo.
10	12	♂	(+)	(+)	After treatment	5-10	10 da.
11	16	♂	(+)	(+)	After treatment	5-10	10 da.
12	8	♂	(+)	(+)	After treatment	5-10	2 wk.
13	17	♂	(-)	(-)	(-)	5-15	2 wk.
14	5	♂	(+)	(+)	After treatment	5-10	1 mo.
15	8	♂	(+)	(+)	After treatment	5-10	1 wk.
16	12	♀	(+)	(+)	After treatment	5-15	12 da.
17	16	♂	(+)	(+)	After treatment	5-25	20 da.
18	10	♂	(-)	(-)	(-)	5-10	1 yr.
19	6	♂	(-)	(+)	(-)	5-15	2 da.
20	11	♂	(+)	(+)	Uncertain	5-15	20 da.

and night blindness are very frequent; the Medical College of Luknow (India) made a special note in their questionnaire of 568 cases of xerosis.

This Uyemura syndrome is therefore scientifically very interesting; it shows us a symptom (white spots in the fundus) which is closely related with transient night blindness. In addition to this type of retinal affection (white spots of the fundus combined with night blindness and xerosis) there are two other diseases which resemble it to a great extent:

1. Retinitis punctata albescens which is related to retinitis pigmentosa and is characterized by white points of the fundus, night blindness, diminished central vision, restriction of visual fields, attenuation of retinal vessels, atrophy of the papilla and, as a rule, a slow deterioration.

2. Fundus albi punctatus with night blindness, beginning from childhood, shows similar white points of the fundus, which do not involve the macular region. The vessels of the retina, just as vision and visual fields, are normal, provided the illumination is good.

This fundus albi punctatus is therefore well differentiated from retinitis punctata albescens, especially because the latter is a progressive disease and the first is stationary. This was recently shown again by Franceschetti and Chomé-Berciox³ (1951) who examined such a patient, aged 59 years, and found the condition stationary 49 years after the first eye examination.

The fundus pictures of fundus albi punctatus with night blindness and the syndrome of Uyemura are exceedingly similar but still there is no doubt that they are entirely different diseases. Uyemura's syndrome may have a sudden onset of night blindness and its etiology, A-avitaminosis, is evident by the xerosis conjunctivae and the effect of treatment—the white spots may disappear.

It is noteworthy that Franceschetti and Chomé-Berciox agree with the opinion of Lauber⁴ (1910) that fundus albi punctatus with night blindness should be related to congenital idiopathic night blindness or Oguchi's disease.

K. Wolfstrasse, 14.

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A NEW SUTURE*

FOR RESECTION OF THE HORIZONTAL ROTATORS

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Cleveland, Ohio

The use of two sutures in securing a resected muscle to the globe is standard prac-

tice with a large number of ophthalmic surgeons. The extra security and the lack of lumping of the muscle tendon are considered adequate recompense for the additional time required. A lucid description of such a technique is given by Stallard.¹ That this could

and Geck, Inc.,[†] who were kind enough to prepare this suture and put a number of them at my disposal. The assistance of Miss Doris Goodman, who prepared the accompanying illustrations, is also acknowledged.

¹ Now Surgical Products Division, American Cyanamid Company, Danbury, Connecticut.

* From the Laboratory for Research in Ophthalmology and the Eye Service, Department of Surgery, Western Reserve University.

I wish to acknowledge the co-operation of Davis

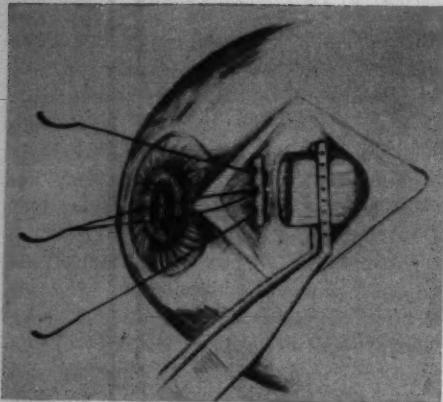


Fig. 1 (Potts). Centripetal insertion of triple-armed suture after freeing muscle from globe.

be accomplished more conveniently and expeditiously was suggested by the triple-armed suture of de Wecker.² Such a suture, though easy enough to prepare with silk and needles which have eyes, has not been available in catgut with a swaged needle until this product was prepared for me by a United States manufacturer. The suture itself is an ordinary 4-0 double-armed plain catgut suture with an additional needle swaged to its center. The needle-eye size required makes it impractical to slip a third needle over the end of an ordinary double-armed suture. A

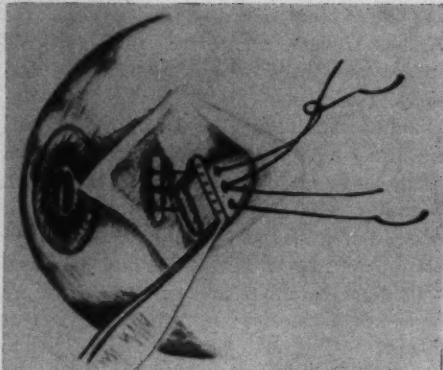


Fig. 3 (Potts). Two sutures created by cutting off center needle, are tied.

"French" snap-eye needle, if small enough, will work if the gut is not cut by the needle eye.

The conjunctiva is opened, and the muscle dissected free of its attachments in the conventional manner. The muscle is then grasped with the Jameson forceps, just distal to the intended point of resection measured without undue tension by a pair of calipers. The tendon is then cut free of the globe close to its insertion, leaving a stump of some 1.5 mm. in width. If a slight advancement is desired together with the resection, the central needle of the triple-armed suture is then passed through the muscle stump toward the limbus. The other two needles are passed through the upper and lower margins of the stump respectively (fig. 1). The center needle is then passed through the muscle tendon, some two mm. proximal to the Jameson clamp, and the two end needles are passed through the corresponding upper and lower margins of the muscle tendon, some one mm. from the edge (fig. 2). At this point the central needle is cut free, thus creating two independent sutures. Slight traction on one of the two marginal arms suffices to identify the central arm attached to it (fig. 3). Each of the two sutures is then tightened and tied and, after both knots are completed, the muscle is resected close to the clamp (fig.

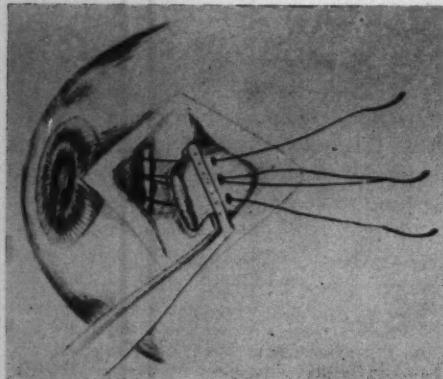


Fig. 2 (Potts). Insertion of suture through muscle proximal to clamp.

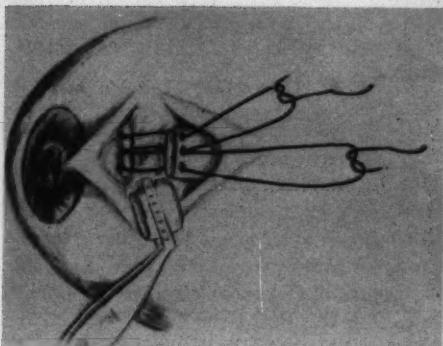


Fig. 4 (Potts). Resection completed. (Sutures loose here to show relationships; in actual procedure they are tight before resection.)

4). (For clarity the resection is shown in this illustration before the sutures have been drawn tight.) The end-result—two individual sutures—is shown in Figure 5. The conjunctiva is then closed in the conventional manner.

It should be noted that if one does not desire advancement and prefers, instead, the security of a whip stitch, the suture may be inserted in the reverse order; that is, through

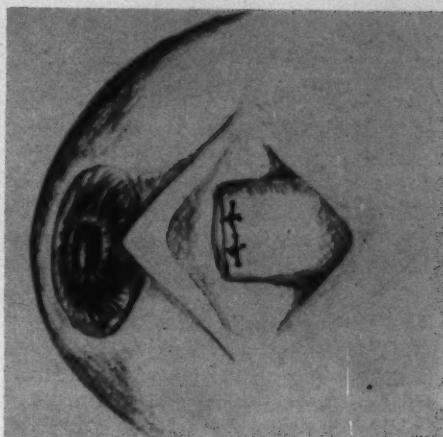


Fig. 5 (Potts). Final position before closure of conjunctiva.

the muscle tendon first. The upper and lower marginal sutures then may be whipped once through the tendon before inserting all three needles through the muscle stump.

This suture has given excellent results in my hands over the past 12 months.

2065 Adelbert Road (6).

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NEW INSTRUMENT COMBINING TWO SETS OF SCISSORS*

RAMÓN CASTROVIEJO, M.D.
New York

During the last few years a good many kinds of specialized scissors have been designed for particular maneuvers used in eye surgery. The surgeon often requires two pairs of scissors to complete a section; such,

for example, as right- and left-handed scissors for performing cataract incisions. I have thought of combining two such pairs of scissors into one instrument, which would eliminate the confusion that sometimes arises when at a critical moment the surgeon finds that, instead of a set including right- and left-handed scissors, he has two pairs of left-handed or two pairs of right-handed scissors.

By using a spring-action mechanism two such pairs of scissors can be combined, as illustrated in Figure 1† designed for cataract

* From the Department of Ophthalmology, St. Vincent's Hospital, The New York Eye and Ear Infirmary, and New York University Post-Graduate Medical School. Presented before the American Ophthalmological Society, White Sulphur Springs, West Virginia, May 29, 1958.

† This instrument is manufactured by E. B. Meyrowitz, Inc., 520 Fifth Avenue, New York 18, New York, and by Storz Instrument Company, 4570 Audubon Avenue, St. Louis 10, Missouri.



Fig. 1 (Castroviejo). Combination of right- and left-handed scissors for enlarging cataract incisions.

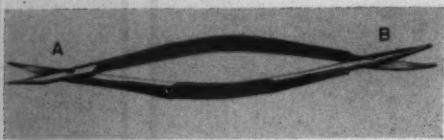


Fig. 2 (Castroviejo). Combination Westcott scissors (A) with sharp points for delicate dissection and the removal of sutures; (B) with blunt points for general utility work.

incisions. Other sets may be made combining two different types of scissors used for other special purposes. One set could be made for iridectomy and iridotomies. Another could be planned for square grafts with the blades at one end of the same length and at the other with the blade which is introduced into the anterior chamber longer than the other and spatulated to minimize trauma to intraocular structures such as the lens or iris. A third set could be designed to complete the section in circular keratoplasties; one end of this set could have blunt and the other sharp points. Another set might combine two pairs of Westcott scissors (fig. 2), one with blunt points (fig. 2-B) for general utility, and the other with sharp points (fig. 2-A) for delicate dissections and the removal of sutures. Still other sets could be designed for other special purposes.

9 East 91st Street (28).

A HAND REST FOR TUDOR-THOMAS METAL STAND*

P. K. BASU,[†] D.O.M.S., AND
H. L. ORMSBY, M.D.

Toronto, Ontario

To facilitate the removal of a graft from the donor eye, a hand rest has been devised which can be fitted to a Tudor-Thomas metal stand. A metal platform with four adjustable and removable legs, having a central hole to fit the top section of the stand rests on the shoulderlike portion of the stand, and can be rotated in any horizontal position.

After placing the donor eye in the socket of the Tudor-Thomas stand the platform is lowered over it (figs. 1 and 2).

3050 Yonge Street.



Fig. 1 (Basu and Ormsby). The hand rest.



Fig. 2 (Basu and Ormsby). The hand rest in use.

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

CHICAGO OPHTHALMOLOGICAL SOCIETY

November 17, 1958

DR. J. VERNAL CASSADY, *President*

ADENOMA OF PANCREAS WITH ORBITAL METASTASIS

DR. E. L. VAN BUSKIRK presented the case of a 34-year-old man whose chief complaints were diplopia and headache. Aside from a left hypertropia all findings were normal. In a period of six weeks the hypertropia increased and proptosis of the left globe developed. Vision was suddenly reduced to light perception. Biopsy of the left orbit was negative but an enlarged left supraclavicular lymph node was removed and examination showed an undifferentiated metastatic adenocarcinoma. Death followed in six months and autopsy revealed a pancreatic adenocarcinoma with widespread metastases. The left orbit in the region of the inferior rectus was found to be infiltrated with metastatic tissue.

ENLARGEMENT OF OPTIC FORAMINA

DR. JOSEPH ALFANO discussed the etiology of enlarged optic foramina seen on X-ray examination. The differential diagnosis of this finding includes glioma of the optic nerve, posterior extension of a retinal glioma, gliomas of the chiasm, and developmental malformations. A frequent etiology is von Recklinghausen's disease characterized by café-au-lait spots and a deformed sella turcica giving rise to the so-called "double sella." Usually there is hypothalamic involvement with associated poor appetite, somnolence, and altered carbohydrate and fat metabolism. Dr. Alfano then presented the case of a nine-year-old boy with visual acuity of 20/70 in each eye, pale optic discs, bi-

lateral central scotomas, and a large café-au-lait spot on the left flank. X-ray examination revealed an enlarged left optic foramen. He was seen by another ophthalmologist, a neurologist, and two neurosurgeons and a final diagnosis of a glioma of the optic chiasm was made.

An exploratory craniotomy revealed a normal chiasm and optic nerves. Over a period of the following year vision returned to 20/30 in each eye. The central scotomas disappeared and there has been no change in the appearance of the foramina, the left still being slightly enlarged.

This is then a case of congenital malformation of an optic foramen with a great deal of psychogenic overlay on the part of the patient and of the five physicians who examined him.

Discussion. DR. P. J. LEINFELDER: In the above case, the fact that there may have been a psychogenic overlay brings about a problem that many of us are very much interested in, but I am afraid that these diagnoses are sometimes more readily made in retrospect than they are first-off. The fact that the pupillary responses were equivocal and that the optic nerve may have been normal certainly deserves some respect in judgement, yet it is very easy to say that at this point and very difficult to say it when you are presented with the facts as they exist.

PATHOGENESIS OF PAPILLEDEMA

DR. P. J. LEINFELDER stated that papilledema from all causes looks the same ophthalmoscopically, making an etiologic diagnosis impossible. He then reviewed the historical explanations for papilledema and concluded that the most widely accepted theory is a compression of the central retinal vein as it passes through the vaginal sheaths of the optic nerve. However this does not explain the fact that papilledema is limited to

the disc and does not involve the surrounding retina.

It is apparent that the extent of the edema in papilledema (its confinement to the disc itself) conforms to the area that is supplied by the nonretinal arterial circle of Zinn. Does this circumstance offer an explanation for papilledema from any cause? Edema may occur because of passive congestion in which capillary and venous pressure is sufficiently high to prevent the normal reabsorption of tissue fluids. There is then a manifest edema of the tissues. This event occurs in increased intracranial pressure because the raised pressure in the central vein impedes the return flow from the capillaries of the nervehead. Since the circle of Zinn is a lower pressure arterial system than the central retinal artery, stasis more readily occurs in the area of the disc than in the retina.

In inflammation involving the lamina cribrosa or the immediate retrobulbar portion of the nervehead congestion of the disc blood vessels and edema of the tissue is a natural component. The extent of papilledema will be dependent upon the severity of the inflammation and its proximity to the disc. The fact that in some instances the inflammation and consequent edema are the result of degeneration caused by certain vascular diseases (vascular pseudopapillitis of François, Bull. Soc. Franç. d'ophtal., 1956; temporal arteritis; and vascular neuritis of Iggersheimer, Tr. Am. Ophth. Soc., 1957) may explain the absence of inflammatory signs in the posterior vitreous in many cases of papillitis.

Vascular and blood diseases often produce edema of the nervehead. Occasionally this is due to increased intracranial pressure resulting from the effect of the primary disease on the brain, but more often it is due to an inadequate vascular supply to the nervehead (and sometimes retinal) tissue. Lack of oxygen caused by sluggish circulation results in a relative acidosis of the tissues and the accumulation of fluid in the region. This state persists as long as inadequate circulation and

nutrition continue. Improvement of the general state of the patient makes possible a more normal circulation which results in disappearance of the disc edema.

Thus edema of the nervehead is caused by congestion and stasis in the capillaries of the disc tissue that are derived from the arterial circle of Zinn. Since these vessels are independent of the retinal circulation, the retina does not take part in the edema. Because of the vascular supply of the area, papilledema from any cause will have the same appearance.

Discussion. DR. L. H. LASSITER: Dr. Leinfelder's incisive thinking on the mechanism of papilledema is logical, provocative, and very useful.

Many of us have experienced discomfort when we became too deeply involved in explaining papilledema to medical students or nonophthalmologic colleagues. The inevitable question, "Why is the edema limited to the region of the disc?" could be anticipated without enthusiasm.

A second question frequently asked is "Why does papilledema from vascular, intracranial, inflammatory, and all other causes look more or less alike?"—or—"Can you make etiologic statements about the papilledema from its appearance?"

Dr. Leinfelder's work sheds a great light on these troublesome questions and goes a long way toward clearing up the mechanism of papilledema in general. Since the circle of Zinn is supplied by capillary anastomosis to the central retinal artery and vein as well as the choroidal circulation, we may see it as the weakest link in the chain—the first to break down in venous stasis, arterial insufficiency, or local inflammatory procession.

I should, however, like to ask Dr. Leinfelder first, how do we know that the circle of Zinn is a relatively low pressure part of the arterial tree, and, second, what he feels to be the dominant mechanism of papilledema in advanced hypertension. Is it due to increased intracranial pressure from brain edema; from increased venous pressure;

from arterial insufficiency, or from a combination of the three?

Finally what is the significance of absence of venous pulsation in early papilledema and how reliable is this sign?

Alexis Carrell once said that the greatest need of humanity is for more people with synthetic minds—the rare gift of gathering facts and combining them to explain the unknown. It would seem that the foregoing paper is a good example of this type of work.

DR. JOSEPH ALFANO: Dr. Leinfelder's concept of papilledema is certainly entertaining. His original thesis is that venous congestion and obstruction is followed by congestion in the capillaries of the circle of Zinn which are low-pressure vessels from the choroidal system. This results in changes in tissue pH and subsequent imbibition of fluid. My main grievance with papilledema, as we know it, is that everybody harps on the vascular aspects of it and neglects the physiodynamic aspects of it—of the optic nerve sheaths and the optic nerve space. These are living structures. They are dynamic structures. We have been working on this problem at Northwestern University for several years and I will present a few of my unpublished observations. They may be correct or incorrect. I mention them only to present the fact that perhaps we are neglecting a very vital structure, the optic nerve sheath or, if you will, the optic nerve sheath and the dynamic subarachnoid space.

In our study we have removed the globes and optic nerves from dogs via transcranial approach. The free end of the optic nerve is then tied off, making a closed pouch of the subarachnoid space. A 27-gauge needle is then threaded into this space and a solution of methylene blue forced in under varying pressures. At pressures of 50 and 100 mm. Hg, the subarachnoid space is distended and there is a pronounced bulge at the cul-de-sac of the optic nerve sheaths at the posterior surface of the globe. At pressures of 150 and 200 mm. Hg, the dye spreads onto the pos-

terior surface of the globe for a distance of three to four mm. from the disc. The spread gets larger as the pressure is increased. It is therefore likely that with a sudden increase of intracranial pressure such as that following a rupture of an aneurysm there is a rush of cerebrospinal fluid up the optic nerve sheaths distending the cul-de-sac behind the globe. This results in compression of the peripapillary vessels and a rupture of small vessels on or close to the disc. With pressure less than 50 mm. Hg there is no bulging of the cul-de-sac and it is probably in these cases that papilledema results.

However, in another series of experiments the skulls of anesthetized dogs were trephined and a pressure system attached. Intracranial pressure was kept elevated for periods as long as eight hours. At the end of this time no papilledema was visible.

DR. LEINFELDER: Dr. Alfano's discussion is stimulating and I think that it brings up a lot of very important considerations. He knows that the dilation of the terminal end of the vaginal sheath has long been recognized as the limit of the choked disc. It, however, was felt or explained away by saying that it is a late manifestation and not seen at all times. I think that that isn't valid criticism and I do think that the work should continue.

The septa in the optic nerve sheath—I wasn't aware that they were as dense as he finds them and I assume that he was working on cadaver eyes or post-mortem eyes. (Dr. Alfano stated that he was working on excised dog eyes and optic nerves.)

There is a little problem in working on dog eyes. The early work done in 1925 in which a choked disc was attempted in dogs was an attempt to raise the intracranial pressure in a novel way. They placed large amounts of psyllium seeds in the brain. After being left there for 24 hours these seeds would swell up to an enormous bulk and they found that it was exceedingly difficult by any means to produce a choked disc in dogs. They could do it occasionally. How-

ever, I think that is beside the point. This type of work should continue because it brings enlightenment to things that are not now known.

The fact though that you did not get a choked disc in eight hours should not discourage you. Most people now feel that the report of the man being in an automobile accident, where you run up and look in his eye with the ophthalmoscope immediately after the accident and see a choked disc is all fantasy.

It perhaps takes from 24 to 36 hours before a choke will form under most circumstances. If there is a rapid increase in intracranial pressure, the patient perhaps may die before you get a chance to look at his discs. It is only under those circumstances, where there is a rapid rise in intracranial pressure, that you are apt to get hemorrhages.

I am very fascinated by your study, Dr. Alfano, and I do think by all means it should be continued.

To answer the question on the importance of absent venous pulsation in early papilledema, if there is a spontaneous pulsation of the central retinal vein, I think you have one chance in a million that it is edema of the disc, no matter what it looks like. If you can produce a pulsation by a light pressure on the globe, I still think the probabilities are very much against it being a choked disc. I have had word that Dr. Walsh has found one case in which there was an increase in intracranial pressure and pulsation in the central retinal vein. That, I think, is the frequency in which you may expect to find it—one case that is known.

David Shoch,
Recording Secretary.

COLLEGE OF PHYSICIANS
OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

October 23, 1958

HAROLD G. SCHEIE, M.D., *Chairman*

FUNCTIONAL RESULTS WITH CONTACT LENS

DR. PHILIP G. SPAETH (by invitation): This paper dealt with the optical, physiologic, and some of the routine problems associated with the functional results with contact lenses in unilateral congenital cataracts with high myopia. The importance of early treatment because of associated amblyopia was stressed. Contact lenses were used in these patients to minimize the aniseikonia which is necessarily present. The functional results in the patients—percentage of patients with first, second, and third degree fusion for near and far—was the main essence of the paper. Of those patients satisfactory for contact lenses, 74 percent obtained third-degree fusion.

RETAINED GLASS FOREIGN BODIES IN ANTERIOR CHAMBER

DR. P. ROBB McDONALD AND DR. MILA J. ASHODIAN (by invitation) presented four cases of particles of glass in the anterior chamber. Three of them were unrecognized at the time of the accident, one for nine years and one for 13 years. They all had a history of injury in which glass was involved, and all demonstrated photophobia, blurred vision, and corneal edema. One case also had a persistent mild iridocyclitis. Gonioscopy proved the only satisfactory method to identify these foreign bodies.

Operative removal of the foreign body resulted in remission of symptoms and clearing of the corneal edema but, as to be expected, the corneal scarring persisted. At operation, a large (150 and 180 degree) corneal section must be made, and the cornea may have to be folded on itself so that the surgeon can see the angle. A loup or operating microscope may be necessary to visualize

the foreign body, once the angle is exposed.

It is important to examine gonioscopically all patients who give a history of ocular injury involving glass. Failure to detect glass following such an injury may result in loss of compensation benefits to the patient and other legal entanglements.

RETINAL FOLDS IN ORBITAL EXPANDING LESIONS

DR. THOMAS R. HEDGES, JR., AND DR. I. H. LEOPOLD described two patients with orbital expanding lesions who showed typical parallel retinal folds or corrugations of the posterior pole. The orbital pathology was due to fibrous dysplasia in one and metastatic hypernephroma with metastasis to the orbit in the other. The characteristics of this type of direct impression of the globe from an intraorbital lesion were described in detail and the literature was reviewed. It was emphasized that these folds probably occur much more frequently than they are described and occur in a multitude of conditions, including non-neoplastic forms, such as exophthalmos associated with thyroid disease.

CATARACT EXTRACTION BY MODIFIED SMITH TECHNIQUE

DR. RICHARD A. ELLIS: The methods of intracapsular cataract extraction developed by Col. Henry Smith were reviewed and three illustrative diagrams were shown. Then the method developed and performed by Sir Henry Holland in India and Pakistan was demonstrated with diagrams and photographs taken during cataract surgery. In essence, the modified Smith technique developed by Sir Henry Holland is one which

delivers the cataract intracapsularly by means of external manipulation. However, the following limitations and contraindications are considered most essential:

1. This procedure should not be attempted in a plethoric, short-necked, corpulent, tense person.
2. It should not be attempted in so-called dangerous eyes (ox-eye); such eyes in which the upper lid cannot be lifted easily from the globe, as in high myopia or exophthalmos.
3. It should not be performed in cataracts of adults under the age of 45 to 50 years.
4. It should not be performed in cataracts associated with glaucoma.
5. It should not be performed if there is any evidence of positive pressure after the anterior chamber is entered.
6. If legitimate pressure does not succeed in dislocating the lens, this method should not be further pursued.

7. It should not be used in congenital, traumatic, and complicated cataracts.

Adhering to these limitations, Sir Henry Holland and his son, Ronnie Holland, have obtained excellent results in cataract surgery. They believe that the incidence of vitreous loss is not over two percent, and that fewer lens capsules are broken. Another advantage of this procedure is that no instrument is put into the anterior chamber of the eye. This is especially important in cases of endothelial dystrophy, since no instrument touches the posterior corneal surface. It may also decrease the possibility of postoperative infection.

William E. Krewson, 3rd,
Clerk.

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EPIDEMIOLOGY OF TOXOPLASMOSIS*

For the host it is important to live on good terms with his parasites; but for the parasite it is equally important to live on good terms with its host, and in this the protozoon, *Toxoplasma*, is notably successful. Serologic evidence indicates that it has infected from

four percent (Navajo Indians)¹ to 94 percent (Guatemalans)² of adult human populations. The Eskimos of Alaska, alone of those tested, are apparently free.³ In this country between 20 and 40 percent appear to have been infected.³

In addition to its wide geographic distribution *Toxoplasma* has an amazingly wide host range. It seems to be capable of infecting all species of mammals, many birds, and

* Reprinted from *The Lancet*, April 25, 1959, pp. 869 and 870.

some reptiles, though not amphibians.⁴ Nor is it just an occasional invader. Between five and 60 percent of cats and dogs,⁵⁻¹⁰ 34 percent of wild rabbits,¹¹ five to 50 percent of cattle,¹ 40 percent of goats,¹⁻³ 15 to 40 percent of pigs,^{5,12-14} and five to 60 percent of sheep,^{1,15} have been found infected. In this issue (Lancet, April 25, 1959, p. 881) Mr. Rawal describes serologic evidence of Toxoplasma infection in 12 percent of pigs and 11 percent of one and 21 percent of another series of sheep slaughtered in Sheffield. Still more definite evidence of infection is given by his isolation of the parasite from six percent of his second series. A higher incidence in samples taken on some days than others suggests a varying prevalence, which Feldman and Miller¹ found in herds of cattle.

Despite the vast amount of infection, Toxoplasma rarely does harm. The fetus is particularly susceptible, and congenital infection is well known. This may be manifested by jaundice, enlargement of liver and spleen, and skin rashes; such cases have simulated hemolytic disease of the newborn.¹⁵ Alternatively it may give rise to hydrocephaly (which may not be externally apparent), chorioretinitis, cerebral calcification, and convulsions or other manifestations of nervous involvement.¹⁶ The most constant of these signs is chorioretinitis, which is found in 80 percent of cases.¹⁷ This may be the only sign and escape recognition till later in life, perhaps when the child first tries to read. Some 20 to 35 percent of cases of chorioretinitis are thought to be due to Toxoplasma infection,¹⁸⁻²⁰ how much of this is congenital and how much acquired is not known. Because antibodies are rarely found in young children, except in the first few months of life when they may result from passive maternal transfer, and because they steadily increase in frequency with advancing years, it may be assumed that infection can be acquired throughout life. Usually infection after infancy passes unrecognised. Sometimes, however, it causes lymphadenopathy; some five to seven percent of cases

of "glandular fever" unaccompanied by a Paul-Bunnell reaction are due to toxoplasmosis.^{21,22} Rarer manifestations are myocarditis^{23,24} (which has been found in this country), encephalitis,²⁵ and a severe and often fatal typhuslike illness.²⁶

The infection, being so prevalent and so widespread might be expected to be transmitted in some simple way. Yet, in man at least, we still know of no natural means of transmission other than congenital, and this accounts for very few cases. For congenital infection to occur it is commonly held that the mother must become infected during pregnancy. Weinman,²⁷ however, believes that it can result from chronic infection, and Toxoplasma is known to persist for up to 32 months in the human body.²⁸ In mice (for what this is worth) Beverley found that infection in successive pregnancies, even up to the fifth litter after the initial infection, was not uncommon; and he observed congenital transmission of Toxoplasma from mother to daughter through five generations.²⁹ So in mice infection could continue without introduction from outside. This is, however, most unlikely to apply to man; for if it did, antibodies would not be rare in infants or increase with age.

The multiplicity of possible sources of infection complicates the search. In the vicinity of one congenitally infected baby, Toxoplasma was found in cats, mice, pigeons, hens, and ducks.³⁰ Man's domestic animals have often been suspected, and there is little doubt that persons in close contact with dogs or cats ill with toxoplasmosis can acquire infection from them, through feces, urine, or saliva. This does not account for cases where there has been no close contact with a pet, and it is hard to reconcile with the finding of Beverley and his colleagues that Toxoplasma antibodies were as common in people who did not keep dogs as in those who did.³¹ The existence of a parasitemia, the superficial resemblance of Toxoplasma to *Leishmania* and *Trypanosoma*, and the reports in a few cases of tick-bites

preceding illness has led to investigations, so far fruitless, of transmission by a blood-sucking arthropod.³¹ Rodents become infected when they eat the flesh of animals dead of toxoplasmosis. This suggested that human infection might come from infected meat. It was with this in mind that Rawal examined pigs and sheep for toxoplasmosis with the successful results reported in this issue. As he points out, human infection could come from eating raw mutton—and, he might have added, raw pork. It is, however, hardly conceivable that enough raw meat is eaten in this country to account for the high prevalence of human infection; and, if raw meat were responsible, infection would be expected, by analogy with trichinellosis, to be commoner in women than in men.³² In fact the prevalence is the same in each sex. Evidence that cooked meat does not cause Toxoplasma infection was obtained by Rawal when he examined sera from vegetarians and meat-eaters in Bombay: the prevalence of infection was the same in each group.³³

The way, or more probably ways, in which toxoplasmosis is spread have yet to be found. A lead worth following was given by Cathie³⁴ when he found Toxoplasma in the saliva of a child. There are few fomites so widely spread, and in the search for an animal source it should not be forgotten that the animal with which man is most in contact is man.

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CORRESPONDENCE

LECTURE TOUR IN LATIN AMERICA
(Panamá, Colombia, Venezuela)

January-February 1959

Editor,
American Journal of Ophthalmology:

A lecture tour in Latin America organized by the esteemed director of the Pan-American Association of Ophthalmology, Dr. Moacyr Alvaro, is a memorable experience

in many ways. First of all, the traditional and well-known hospitality of our Latin American colleagues makes the visitor feel that he is welcome and that his efforts are appreciated. Only a few of the many courtesies extended to me may be mentioned: dinner on top of the El Panama Hilton under the stars and honorary membership in the Panamanian Ophthalmological Society in Panama, a tour through the interesting collections of Indian relics and luncheon at the stunningly modern country club in Bogotá, Colombia, and a scenic drive from Caracas to the seashore (Venezuela). Furthermore, one is quite impressed by the knowledge and skill exhibited by our Latin American colleagues and often also by the physical plants of their institutions. The language barrier does not seem to constitute a major obstacle, due to the proficiency of our Latin friends in English and French. Nevertheless, our relations with them would become even more cordial and the hemispheric fellowship could be furthered a great deal more if we "Norteamericanos" would make a more serious effort to speak the language of our neighbors at least to some extent.

In Caracas, the preparations for the Pan-American Congress of Ophthalmology, January 31 to February 7, 1960, are in full swing. The coming meeting promises to be a very interesting one. The perfect climate and the fantastic city of Caracas itself will certainly add to the general enjoyment of those who decide to participate.

(Signed) Frederick W. Stocker,
Durham, North Carolina.

VI. PAN-AMERICAN CONGRESS

Editor,
American Journal of Ophthalmology:

I have the pleasure of giving the following information concerning the VI Pan-American Congress of Ophthalmology to be held in Caracas from January 31 to February 7, 1960.

1. Travel by airplane is the most practical. There are direct flights by P.A.A. and L.A.V. from New York to Maiquetia (International Airport). Caracas is linked by a superhighway with the airport, and the trip takes only 20 minutes.

2. It was decided in Chicago that hotel reservations must be made directly through travel agencies. The hotels recommended are: Tamanaco, Avila, El Conde, Potomac, Nacional, Ambassador, Waldorf, Alcázar, Anauco, El Comercio. The Humboldt hotel, situated on top of Avila mountain at 2,200 meters above sea level, is about 20 minutes from Caracas.

3. Citizens of the United States and Canada should have passports, Venezuelan visas and certificates of smallpox vaccination. The Venezuelan consulates in these countries will supply all information concerning necessary documents.

4. There is no duty on personal belongings such as used clothing, cameras and projectors.

5. Details about the commercial and scientific exhibitions can be obtained from Dr. James H. Allen, New Orleans, or Dr. William L. Benedict Rochester, Minnesota. There is sufficient space in the Ciudad Universitaria, the place of the Congress. The exhibits will be protected by police guards day and night.

6. The scientific meeting will be held at University City where a very large auditorium will accommodate 3,000 persons. It is equipped with earphones, thus facilitating simultaneous translation.

7. The following doctors have been invited as honorary members: Sir Stewart Duke-Elder (London); E. Velter (Paris); L. Paufique (Lyon); R. Thiel and Mrs. Thiel (Germany); Alan C. Woods, Derrick Vail and Frederick C. Cordes (USA); Hans Goldmann (Berne); Horacio Ferrer (Cuba); Pereira Gómez (Brazil).

8. Free papers will be accepted and should be submitted to the chairman of the Program Committee, Dr. James H. Allen, 1430 Tulane

Avenue, New Orleans, Louisiana. Movies will also be accepted, provided they have not been shown previously and that the author will be present at the meeting to answer any questions regarding the movie.

9. Caracas is a very beautiful city with an altitude of 2,000 feet which makes its climate quite agreeable, with a temperature median of 68°F. during January and February.

10. The Caracas executive committee has planned a very interesting social program.

11. The VI Pan-American Congress of Ophthalmology will have the full backing of the government of Venezuela through the Minister of Public Health.

(Signed) Rodolfo Hernández,
Secretary of Committee of Caracas,
Av. Bolet Peraza, quinta "Marruca"
Santa Mónica, Caracas, Venezuela, S.A.

EYE STUDY CLUB

April, 1959

Editor,
American Journal of Ophthalmology:

The second meeting of the Eye Study Club was held at the Broadmoor Hotel, Colorado Springs, from March 29 through April 3, 1959. Twenty-three members and their wives were present. The subjects outlined in the printed program were enlarged upon and several conclusions of major interest were reached.

1. The group generally agreed that glaucoma surveys should be limited in scope (covering a fixed group); educational in nature; not in any way promotional. It was agreed that the general practitioner needed more education in regard to glaucoma and particularly the proper use of the tonometer. Frey suggested that the Lions Clubs utilize their funds for spot radio educational "squibs" and that ophthalmologists generally try to "point" the Lions Clubs toward higher goals.

2. Contact lenses were discussed at length. The group generally agreed that much greater stress should be placed on this field by the ophthalmologist. Scruggs presented the Texas plan which was felt to be definitely beneficial to the patient and the proper control of contact lens fitting. Louis Girard pointed up the many advantages of contact lens wear when properly fitted and the advantages of certified contact lens technicians. The possibility of creating certified refractionists in acceptable areas was discussed at length. This naturally brought up the subject of dispensing which was discussed at length and with some heat. Except for a few individuals who felt that dispensing approached rather closely to a "business" viewpoint, the members were generally agreed that dispensing by or under the control of the ophthalmologist actually provided the patient with more benefits. Those members present who dispensed stated that they actually bent over backward to maintain the integrity of the doctor-patient relationship. Their arguments, while not completely convincing to all, were certainly accepted as being utterly sincere and honest.

3. Retinal detachment surgery was discussed at great length by the group as a whole, but especially Norton and Colyear. Light coagulation, tube vs. buckle, polyviol stif, silicone tubing, and so forth, were all covered with great interest.

4. Intraocular lenticular lenses were discussed. Generally speaking, they were condemned except under strict control in teaching centers. The fact that no truly inert plastic is known and the general satisfaction with aphakic contacts pointed up the discussion.

5. Chymotrypsin was discussed at some length by the members of the group present who have used the drug. Louis Girard presented the results of studies at his institution with both Chymotrase and Zolese. Most of the members present felt the drug should be used only in the most selected cases and that reservations were still present before gen-

eral use should be considered. Local vs. general, catgut suture, monofilament silk, balanced salt solutions vs. normal saline, and other related subjects were also discussed.

6. Orbital implants brought forth some heated discussion especially as related to evisceration as a cosmetically acceptable procedure. The major objection to evisceration seemed to be the possibility of intraocular melanoma. With melanomas, enucleation was felt safest.

7. Tonography in glaucoma was capably discussed by Winston Roberts. The group discussed miotics, miotics plus mydriasis (Neosynephrine, Epitrate), criteria for glaucoma surgery. Generally speaking, the group fell back on the tried and true criteria for glaucoma and utilized tonography occasionally. Tonography as an indicator for potential glaucoma cases was considered feasible as an office procedure only in cases with familial incidence.

8. A and V syndromes were discussed at some length. A. D. Ruedemann, Jr., presented his version of these syndromes.

9. On Thursday, free papers were presented. Maher presented a case of "frozen cornea." Kearns presented several cases of corneal edema associated with Chloroquine therapy for arthritis.

Steroids in ophthalmic therapy was discussed at length by every member present. In conclusion each member presented his treatment for "central serous retinopathy." The relation of the use of steroids to the generation of gastric ulcers and in the ulcer-type personalities was reiterated. The overall treatment of central serous disease revolved around reassurance, vitamin B₁₂ injections, tranquilizers, tobacco withdrawal. The relationship of this disease to intelligent, hyperkinetic individuals subject to emotionalism associated with loss of vision indicated that real care was required in therapy even though the bulk of patients achieved complete recovery. Bedrest was indicated by some and over half the members present utilized steroids. Ruedemann

indicated that parenteral steroids should be supervised by an internist.

Bayard Colyear mentioned that patients with bilateral simple glaucoma and unilateral detachment invariably showed improvement in glaucoma status following detachment surgery (improvement in the operated eye).

Stanley Truhlsen discussed again the use of Epitrate and its value in chronic simple glaucoma: a single drop combined with pilocarpine in the morning. Several members mentioned side-reactions, and the newer miotics.

Ruedemann mentioned vertical muscular imbalance and myasthenia gravis.

Corneal transplants were discussed by Naquin, Girard, Lassiter, Roberts, et al.—rotating graft, cornea scleral grafts, early grafting for Fuchs' endothelial-epithelial dystrophy, blood types and corneal grafts, antigenicity and corneal grafts.

Howard Naquin mentioned the pterygo-palatine block instead of superficial petrosal block for too many tears. Girard mentioned the use of a hair dryer for bullous keratopathy.

Finally, new members were elected and the 1960 meeting was decided for Nassau, Bahamas. A congenial, stimulating group parted in good company on Friday, April 3, 1959.

(Signed) A. D. Ruedemann, Jr.,
Detroit, Michigan.

BOOK REVIEWS

TREATMENT OF CANCER AND ALLIED DISEASES: VOLUME III (Tumors of the Head and Neck). Edited by George T. Park, M.D., and Irving M. Ariel, M.D., New York, Paul B. Hoeber, Inc. (Medical Book Department of Harper & Brothers) 1959, ed. 2. 781 pages, 1028 illustrations, bibliography, index. Price: \$30.00.

This book is the second edition of volume III of the nine-volume system on *Treatment of Cancer and Allied Diseases*. Volume III,

consisting of 52 chapters, written by 10 authors, was edited by Park and Ariel and deals with 16 tumors of the head and neck. Two of the chapters discuss ophthalmologic tumors.

Chapter 32, consisting of 20 pages, was written by Cecil S. O'Brien and discusses the treatment of tumors of the eyelids and orbit. Considerable of the space, which is well illustrated, is devoted to the removal of lid lesions and the lid reconstruction by plastic surgery. Under roentgen therapy, rather large penetrating doses are prescribed which the editors of the book, in a footnote, state they feel are rather more penetrating than necessary. The use of beta rays from radioactive strontium is mentioned only in a footnote by the editors. It is noteworthy that except for one article published in 1953, all other references in the bibliography of this chapter antedate 1950.

Chapter 33, consisting of 10 pages, was written by Ira S. Jones of Columbia University and is an excellent resumé of the presently accepted treatment of tumors of the eye. This is particularly true of radiation therapy of retinoblastoma and, while the description is only a resumé of the most recently accepted procedures, the bibliography contains all the important recent references.

These two chapters would be of interest to the general oncologist but would be inadequate for the serious student of treatment of ophthalmic oncology.

The printing, illustrations and paper leave little to be desired. In fact, the general format of the book is excellent and comes up to the high standard that is expected in a Hoeber publication. The index is adequate.

Frederick C. Cordes.

DIRECTORY OF AGENCIES SERVING BLIND PERSONS IN THE UNITED STATES AND CANADA. Compiled by Hilma Saterlee. New York, American Foundation for the Blind, 1959, ed. 11. 222 pages, index. Price: \$3.00.

In general, the agencies listed here "are established nonprofit organizations; they provide services for blind persons, either as their sole function or as an appreciable segment of their programs; they maintain established service headquarters and paid staffs." The reader is advised to check with local health or national organizations concerned with standards of welfare agencies, Better Business Bureaus or the National Information Bureau, in order to get a proper idea of the function and efficiency of a particular agency.

The directory, a most useful tool for the ophthalmologist continually interested in his patient's welfare, records federal agencies (Section I), national voluntary agencies (Section II) and statewide, local and regional agencies (Section III). In addition appendices list professional associations, guide-dog schools, printing and publishing organizations, specialized recording and transcription libraries and other organizations interested in service to the blind.

The directory is more than a list of agencies. Each has a short description of its own function, such as aid to the blind, educational, residential schools, local community schools, libraries, and so forth.

Each ophthalmologist should have this directory in his office desk for ready reference.

Derrick Vail.

AMINO ACIDS AND PEPTIDES WITH ANTIMETABOLIC ACTIVITY. Edited by G. E. W. Wolstenholme and C. M. O'Connor. Ciba Foundation Symposium. Boston, Little, Brown and Company, 1958. 286 pages, 28 illustrations, index. Price: \$8.75.

This is the transcription of a symposium held in London in March, 1958, under the continuing sponsorship of the Ciba Foundation. The subject of metabolic antagonists has become a very broad one and it now appears that almost all antibiotics act by competing with an essential element for cell

growth and reproduction. The cell, apparently taken in by the close stereochemical configuration of the antagonist to the usual metabolite, incorporates the former rather than the latter in its metabolism. In the present volume E. F. Gale postulates that chloramphenicol blocks nucleoprotein synthesis within the cell. (Penicillin theoretically blocks formation of cell-wall peptides.)

A further field of interest is the group of compounds with antitumor properties. A particularly interesting paper in this regard is that by S. Farber on the actinomycins. He covers the chemistry, biochemistry, pathology, and chemical use of this substance in a most coherent fashion. It becomes apparent from reading this article that the surgical or radiational destruction of cancer is at best a limited approach. A more basic therapeutic tool would be the induced maturation of tumor masses via chemical means. This symposium is a step in that direction.

David Shoch.

TRANSACTIONS OF THE PACIFIC COAST
OTO-OPTHALMOLOGICAL SOCIETY, 1958:
VOLUME XXXIX. (42nd annual meeting, Vancouver, B.C., May 11, 1958.) 419
pages, index. Price: Not listed.

The 1958 *Transactions* of the very active regional society known as the Pacific Coast Oto-Ophthalmological Society contains some 10 papers of interest primarily to otolaryngologists but there is some excellent and interesting material among the 14 papers devoted to various phases of ophthalmology. In addition a paper by T. F. Dougherty, Ph.D., on the "Role of anti-inflammatory adrenal cortical hormones in stress," and

one by E. L. McCawley, Ph.D., on the "Present status and future perspective of antibiotics," are of broad interest. Levatin, Tamler, and Winter present an unusual case of sympathetic ophthalmia without clinical signs of uveitis in the exciting eye. Chandler discusses the more common complications of cataract extraction and the management of open-angle glaucoma in two separate papers. Visual aids for the partially sighted are elucidated by Zweng, anticoagulant therapy by Sonntag, and late secondary glaucoma due to trauma by Ellis. Rome in a discussion on heparin in macular degeneration claims improvement in 38 out of 64 patients. Simpson describes visual requirements for drivers of motor vehicles. Oaks, Dorman, and Petty report three cases of serious ocular damage from tear gas and emphasize the dangers in the improper use of this weapon by un instructed persons. Bettman, et al. report a modified radiation treatment of retinoblastomas, carried out in seven cases with a sharply demarcated beam and greater depth, which they believe outweighs the disadvantages of numerous anesthetics and hospitalization. Borley and Snyder report the use of combined lamellar resection with scleral reinforcement in degenerative myopia. Further papers deal with strabismus with emphasis on the psychiatric treatment (Butler), the indications for multiple targets in visual field examinations (Zeller), and the scleral buckling procedure (Friedman).

The wide variety of subjects covered and the pertinent discussion included speak for the dynamic character of this well-established West-Coast organization.

William A. Mann.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Oksala, A. and Lehtinen, A. **Experimental researches on vitreous hemorrhages and on the echogram emitted by them.** Acta Ophth. 37:17-25, 1959.

Citrated blood injected into enucleated bovine eyes formed a clearly demarcated border line with the vitreous. It is assumed that the framework of the vitreous checks the spread of the hemorrhage. When it is destroyed, blood spreads within the vitreous. Determinations with ultrasonic equipment showed that the sound velocity in the blood was 35 to 45 m/sec. higher than in the vitreous; this difference produced a clear reflection when there was a well-defined border line between blood and vitreous. (5 figures, 11 references) John J. Stern.

Radnót, M. **The significance of eyes for the function of endocrine organs.** Orvosi Hetilap 100:201-205, 1959.

Perceptible light exerts, through the eye, a decisive effect on the function of the hypothalamus-pituitary system, and thereby on the function of all endocrine

organs. These examinations are important for human physiology and pathology alike. To date the role of light in water balance, carbohydrate metabolism, and in hemopoiesis has been demonstrated. The daily changes of adrenal function, reflected by the eosinophil count, also have been interpreted by light effect. All these data may be useful from a diagnostic and therapeutic aspect. Gyula Lugossy.

Zehetbauer, G. and Flamm, H. **Achromycin levels in rabbit aqueous and vitreous.** Ophthalmologica 137:108-112, Feb., 1959.

The addition of either citric acid or sodium metaphosphate to single doses of orally (by stomach tube) administered tetracycline, caused a significant increase in the antibiotic concentration in blood, aqueous and vitreous of rabbits. (2 figures, 3 tables, 2 references)

Peter C. Kronfeld.

Zinnitz, Fritz. **A contribution to the pharmacology of the visible light.** Klin. Monatsbl. f. Augenh. 134:161-172, 1959.

In this continuation of the author's studies on the influence of light on the

activity of mice the activity of the mice was followed on a pace-recording device. Two groups of animals could be distinguished. One group showed a higher degree of motility and they increased their activity in red and in neon light. The slower animals increased their activity in green and decreased it in blue light.

The influence of several drugs, a sedative (morphine) a stimulant (acrolein) and an analgesic (phenazonaldehyde), was evaluated. Each of the three drugs caused a shift in the light effects. (7 figures, 4 references)

Frederick C. Blodi.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Christensen, Haaken. *Observations of image movements relative to the retina during fixation.* Acta Ophth. 37:1-16, 1959.

In a series of observations of his own vision the author was able to confirm details of the image migration over the retina during fixation of a point as found by other workers with photographic methods. (3 figures, 1 table, 9 references)

John J. Stern.

Dreyer, V. *On visual contrast thresholds. I. The influence of different areas of positive stimuli.* Acta Ophth. 37:65-79, 1959.

The contrast threshold for small positive stimuli at a high level of adaptation was studied. It emerged that 1. the contrast threshold is not a simple function of the size of the stimulus area, 2. a critical minimum visual angle of about $3'$ exists, above which the contrast threshold is independent of the area of stimulus, 3. with stimuli viewed under smaller angles than the critical visual angle, the product of the Fechner fraction and the area of stimulus is a constant $\Delta L/L \times$

A equals constant), 4. there is a critical minimum background luminance, above which the Fechner fraction has a minimum value, and above which it becomes independent of further increase in the background luminance, and 5. the critical visual angle and the critical background luminance can be considered as thresholds for the validity of the Weber-Fechner law. (5 figures, 2 tables, 13 references)

John J. Stern.

Geyer, Otto Christian. *Experiences with the objective determination of visual acuity according to v. Romberg.* Klin. Monatsbl. f. Augenh. 134:205-212, 1959.

This apparatus uses as an indicator the intensity of a fixed light which is just intense enough to suppress an artificially produced opto-kinetic nystagmus. The actual visual acuity cannot be determined with this method. It is, however, possible to come to certain conclusions as to the probable acuity. The results varied greatly among 240 normal eyes so tested; 138 malingerers were also tested and in about a third of them the acuity obtained by this method was decidedly better than the one admitted by the examinee. (2 figures, 1 table, 4 references)

Frederick C. Blodi.

Gramberg-Danielsen, B. *Direct visibility of X-rays.* Klin. Monatsbl. f. Augenh. 134:172-178, 1959.

X-rays can be made visible after long dark adaptation. They enter the eye without being refracted and are therefore independent of the physical properties of the eye. This method has certain clinical applications. In monocular diplopia physical reasons can be excluded if the diplopia persists when this type of examination is used. Care has to be taken not to stimulate two retinal points with the X-ray beam. The method can also be used in localizing an intraocular foreign body which lies close to the retina, for

evaluating the sense of projection in densely opaque media and in diagnosing a flat, peripheral detachment, as the detached retina loses its sensitivity to X-rays. It is also an ideal method for malingeringers as the patient sitting under a dark hood does not know which eye is stimulated from which direction. The factors are: 80 kV, 4 mA, 10-15 sec., Al filter 1.0mm and STD 65cm. (12 references)

Frederick C. Blodi.

Linksz, Arthur. **Aniseikonia: with notes on the Jackson-Lancaster controversy.** Tr. Am. Acad. Ophth. 63:117-140, March-April, 1959.

In this, the fifteenth Jackson Memorial Lecture, numerous examples are presented to illustrate how small refractive errors can cause important symptoms. Aniseikonia in higher degrees and in later life causes imperfect binocular vision. In lower degrees and in earlier life it causes eye strain.

Eye strain can be caused by compulsion to fusion with lens-induced forced vergence caused by unequal lenses. Under certain circumstances the same results can occur with bilaterally equal lenses. Size lenses can eliminate this cause of eye strain.

The differences in action of prisms, slab-offs, and size lenses are illustrated. The physiologic basis of stereopsis—horizontal image size difference, horizontal vergence movements, and spacial localization—is illustrated.

People with compulsive binocular vision should be corrected for aniseikonia if it interferes with the efficiency of binocular vision or if it is the cause of eye strain. If there is no eye strain it should be ignored. (9 figures, 2 tables)

Harry Horwitz.

Piper, H. F. **Can the quality of visual function in a heterotropic patient be evaluated by the quantitative analysis of**

single functions? Klin. Monatsbl. f. Augenh. 134:227-245, 1959.

The quantitative analysis of certain single functions, for example visual acuity, does not justify sweeping conclusions about the efficiency of an amblyopic eye. (13 figures, 27 references)

Frederick C. Blodi.

Rocco, Alfredo. **Chromatic sense; Holmgren's test.** Arq. bras. de oftal. 21: 275-281, 1958.

Of the various tests of the chromatic sense that of Holmgren has been used since 1876. It has not been used on a large scale, however, for various reasons. It does have value in serving as a check on the Ishihara and pseudoisochromatic charts. The author describes his technique in administering the test in which as many as 125 skeins of colored wool yarn may be viewed by the patient who is then allowed to select those of a certain color and also select those which are most brilliant in color.

In some instances confirmation of the test is made by having the candidate identify colored rockets at night, shot at varying distances. Having evaluated the results of these tests the examiner may then record the finding as normal, deuteranopia, protanopia or their attenuated forms, deuteranomaly or protanomaly. In some cases, only one test is necessary to detect an abnormality, while other individuals require several before a final decision can be made.

James W. Brennan.

Savin, L. H. **Functional spasm of accommodation.** Brit. J. Ophth. 43:3-8, Jan., 1959.

Functional spasm of accommodation occurs rather infrequently and when it is found, it tends to be dismissed as unimportant. It occurs in younger people and is almost always associated with mental distress. In this study, 12 such

patients have been watched for a number of years and in most of them an attack of spasm occurred with emotional stress. Aside from the marked diminution of vision there are few other subjective symptoms. It occurs equally frequently in both sexes and in the various types of ametropia. Treatment consists of refraction, paralysing the accommodation, and therapy for the emotional factor. (2 references)

Morris Kaplan.

Sternberg, R. A. and Raab, K. **Application of a cholinesterase inhibitor in the treatment of "esophoric asthenopia."** Szemeszet 96:20-23, 1959.

The authors report the good results obtained in cases of "esophoric asthenopia" with the cholinesterase inhibitor Chinoortho.

Gyula Lugossy.

5

DIAGNOSIS AND THERAPY

Belfort Mattos, Rubens. **Therapeutics of Brazilian Indians.** Arq. brasil. de oftal. 21:289-292, 1958.

Therapy among the Brazilian Indians is primitive and is semimagic and religious. Diseases are treated by invoking spirits and by the use of elements of local fauna and flora. Other modalities are fumigation, fasting, painting, and incisions. For active treatment medicinal plants are used. A review of the literature indicates that the natives have used roots, leaves, bark, and juices in the form of applications to the lids or as collyria with some degree of success. (8 references)

James W. Brennan.

Callahan, Alston. **A zonule stripper.** Tr. Am. Acad. Ophth. 63:219-221, March-April, 1959.

A zonule stripper with a smooth bulbous end and a reversed shank is described. It is used to sweep away the anterior zonular fibers in the lower half of the posterior chamber. (3 figures)

Harry Horwitz.

Gostin, Seymour B. **The guarded double-bladed scleral resection knife.** Tr. Am. Acad. Ophth. 63:224-225, March-April, 1959.

This sclerotome has two parallel blades separated by a metal guard which limits the depth of their penetration. (2 figures)

Harry Horwitz.

Jones, H. W., Hamilton, W. K. and Ochsner, A. **Symposium: Care of the surgical patient.** Tr. Am. Acad. Ophth. 63:166-178, March-April, 1959.

Jones, H. Walter. **Preoperative evaluation of the patient.** pp. 166-169.

In taking the preoperative history one should carefully search for the use of adrenocortical steroids, tranquilizers, and drugs to which addiction is probable. One should also look for allergies, diabetes, anemia, nitrogen retention, thromboembolic disease, and abnormal hormonal states. (5 references)

Hamilton, William K. **Fallacies in choice of anesthetic agent.** pp. 170-173.

This writer does not feel that cardiac disease is a contraindication to the use of cyclopropane, spinal anesthesia, or nitrous oxide. Under properly controlled conditions ether can be used in patients with respiratory ailments and in diabetics. Local anesthesia may be more dangerous than general, in that excessive premedication may be used, severe depressant effects may occur from absorption and discomfort of the patient may be increased.

Ochsner, Alton. **Postoperative surgical care.** pp. 174-178.

The author advises 1. discontinuance of smoking; 2. avoidance of catharsis; 3. antibiotics and vitamin C in presence of infection; 4. hydration of the patient; 5. correction of blood volume deficiency and anemia; 6. correction of hypoproteinemia; 7. the use of steroids if administered during the preceding year and a

half; and 8. psychic and physical rest. Deep breathing exercises, lower limb exercises, and calcium with alpha-tocopherol are strongly recommended.

Harry Horwich.

Kahán, A. and Szeghy, G. **A fluorometer as a simple attachment to the slit-lamp.** Klin. Monatsbl. f. Augenh. 134: 192-195, 1959.

A layer of fluoresceine and gelatine is put on a glass plate. Fluorescent rays will emerge from the edge of this plate separated by total reflection from the direct rays. A calibrated iris diaphragm allows a comparison with the concentration of fluoresceine in the anterior chamber. (2 figures, 7 references)

Frederick C. Blodi.

King, John Harry. **Ball-point eye scissors.** Tr. Am. Acad. Ophth. 63:222, March-April, 1959.

A scissors with a ball protruding and extending forward from the lower blade is described. Its purpose is to minimize chances of cutting the iris when enlarging the section. (1 figure)

Harry Horwich.

Lerner, Hobart A. **A muscle headlight.** Tr. Am. Acad. Ophth. 63:223-224, March-April, 1959.

A Finoff transilluminator on a long adjustable stem and controlled by a foot switch is described. (1 figure)

Harry Horwich.

Mueller, Klaus. **Observations on the psychomotor behavior of blind children.** Klin. Monatsbl. f. Augenh. 134:213-227, 1959.

One of the most frequently observed phenomenon is the rubbing of the eyes with the fingers (digit-o-ocular phenomenon). This is often combined with rhythmic movements of the body and with masturbation. Other stereotypic

motor anomalies include: nodding of the head, turning on one foot, rotation of forearms, kicking of legs, patting of hands, biting of fingernails and difficulties of speech. (6 figures, 2 tables, 19 references)

Frederick C. Blodi.

Neubauer, Hellmut. **A new apparatus for stereophotography of the anterior segment.** Klin. Monatsbl. f. Augenh. 134: 260-262, 1959.

In this development of the ocular microscope (Leitz) a stroboscopic light is used. (4 figures) Frederick C. Blodi.

Steinvorth, E. and Hoette, E. **A simple method of photographing the anterior segment with a Minox camera and a corneal microscope.** Klin. Monatsbl. f. Augenh. 134:262-265, 1959.

The Minox camera is a miniature camera. It can be attached to one ocular. The other ocular is used for focusing. A stroboscopic light is used. (2 figures, 2 references)

Frederick C. Blodi.

Stevens, P. R. and Chatterjee, S. **Hemorrhage into the lens. A complication of intra-ocular surgery.** Brit. J. Ophth. 43: 42-45, Jan., 1959.

Two patients, 55 and 67 years of age, were treated surgically for acute congestive glaucoma. The procedures seemed routine and convalescence seemed to be proceeding very well when blood appeared on what seemed to be the anterior surface of the lens but which proved to be within the anterior cortex in both cases. In neither case was there a rupture of the lens capsule. This blood has remained unchanged within the lens for 11 months in one case and seven months in the other. (2 figures, 2 references)

Morris Kaplan.

Townsend, R. H. **Two new surgical instruments.** Brit. J. Ophth. 43:61, Jan., 1959.

A Sinclair scissors is modified with blunt tips and spring handles and is advocated for enlarging the corneal section after keratome incision. Foster's scissors needle holder is modified by the use of spring handles rather than the looped finger holders; it is particularly recommended for tying sutures and cutting the knots without changing instruments. (2 figures)

Morris Kaplan.

6

OCULAR MOTILITY

Amidei, B. and Megighian, D. **Electronystagmographic (E.N.G.) analyses of congenital nystagmus.** Riv. oto-neuro-oftal. 33:195-211, March-April, 1958.

In a previous paper the authors reported their E.N.G. findings in congenital nystagmus as related to the position of the head. In this second paper they evaluate the findings in relation to the position of the eyes. From these comparative studies the authors conclude that the position of the head plays a greater role in the inhibition of the nystagmus. (5 tables, 8 references)

William C. Caccamise.

Nicolai, Heinz. **Differences between right and left-sided optokinetic nystagmus in unilateral strabismus amblyopia.** Klin. Monatsbl. f. Augenh. 134:245-250, 1959.

A difference between a right and a left-sided optokinetic nystagmus occurs frequently in children with unilateral amblyopia of strabismus. If the right eye is amblyopic, nystagmus to the left is weaker or absent, and vice versa. This can only be observed when the good eye is covered. (4 tables, 8 references)

Frederick C. Blodi.

Parsons, T. C. and Montrose, M. D. **Extraocular motor disturbances in primary brain tumors.** A.M.A. Arch. Neurol. & Psychiat. 81:182-188, Feb., 1959.

An analysis of signs of impairment of extraocular motility in a series of patients with primary brain tumors is made. A comparison with analysis of the extraocular motor nerve signs reported in large series of similar tumors in the literature is made and mechanisms discussed. The results of this survey suggest that extraocular motor disturbances constitute a frequent and important sign of brain tumor, being exceeded only by pyramidal symptoms, signs of increased intracranial pressure, convulsions, pupillary changes, and mental alterations, including depression of consciousness. The importance of oculomotor nerve palsies in tumors distant from the extraocular motor system is as great as that of abducens nerve involvement. Unilateral involvement of either nerve suggests the presence of a hemispheric lesion; unilateral oculomotor palsy is especially characteristic of temporal lobe lesions. Bilateral or multiple extraocular motor nerve signs suggest basilar or brain stem lesions. The presence of extraocular motor nerve involvement suggested increased intracranial pressure in temporal and hemispheric tumors. (7 tables, 38 references)

Authors' summary.

Rubinstein, K., and Dixon, J. **Myectomy of the inferior oblique. Report of 100 cases.** Brit. J. Ophth. 43:21-28, Jan., 1959.

The authors report a study of 100 myectomies of this muscle at its origin in 89 patients the majority of whom were children. The procedure was done in one, two, three, or four stages. Binocular vision was absent in 77 patients before surgery and did not develop after operation. The overaction of the inferior oblique is never primary but rather is the result of weakness in the contralateral superior rectus or of the ipsilateral superior oblique. The operation used in all these cases was a simple myectomy at

the origin of the muscle through a cutaneous incision under general anesthesia; there were no resultant cutaneous scars. The surgery is done primarily for cosmetic reasons and the cosmetic results are universally good. (2 figures, 3 tables, 16 references) Morris Kaplan.

Weekers, R., Delville-Hacourt, J. and Watillon, M. **Alterations of ocular motility after scleral resection.** Arch. d'opht. 18:409-413, June, 1958.

The authors report motility findings in 12 cases of retinal detachment treated successfully by scleral resection. In each case one or more muscle tendons were sectioned. Four of the patients noted diplopia, five had motility disturbance that did not cause diplopia, and three had normal muscle balance. Of the diplopia cases there were two in which the sectioned muscles were paretic; in the remaining two they were hyperactive. In only one case, however, was the diplopia sufficiently annoying to require corrective surgery. The authors stress that surgery for diplopia due to scleral adhesion presents difficult problems. (5 figures, 3 references)

P. Thygeson.

7

CONJUNCTIVA, CORNEA, SCLERA

Akagi, G., Tsutsui, J., Nanba, I., Shimizu, H. and Nishikiori, H. **The bacterial flora in trachomatous and normal conjunctiva.** Rev. intern. du trachome. 35: 361-370, 1958.

Comparative studies of normal and trachomatous conjunctivas showed that contaminating microorganisms were non-pathogenic and had little influence on the clinical picture. (6 tables, 7 references)

José A. Ferreira.

Alberth, B. **A new method of treating herpetic keratitis.** Szemeszet 96:23-25, 1959.

The author discusses a new operative therapy of herpetic keratitis called incisio corneae. The diseased area is circumcised down to Descemet's membrane with a 7 mm. trephine. In his opinion relief is due to the severing of nerves. Healing ensues within a week. Gyula Lugossy.

Doggart, James H. **Significance of color change in the cornea.** Brit. J. Ophth. 43:13-20, Jan., 1959.

Among the various clinically recognizable types of corneal color are normal or physiological color, congenital coloration, the Hudson-Stähli line, corneal dystrophy, pigmented scars, neoplasms, systemic disease discoloration, pigment derived from the inner eye and exogenous coloration. The exogenous causes may be pigmented foreign matter directly implanted upon the cornea, pigment deliberately introduced into the cornea, medicaments applied to the eye, medicaments introduced elsewhere in the body, contamination by industrial substances, and metallic intraocular foreign bodies. (12 references)

Morris Kaplan.

Goddard, S. J. **Bee sting through the cornea.** M. J. Australia 1:530-531, April 18, 1959.

The sting was apparently implanted directly into the cornea and severe keratitis developed. The sting could not be removed and it passed more deeply to the back of the cornea. (5 references)

Ronald Lowe.

Hertzberg, R. **Delayed mustard gas keratitis: a report of five cases treated by lamellar keratoplasty.** M. J. Australia 1: 529-530, April 18, 1959.

The author describes five patients who received relief of symptoms and improvement of vision (two obtained 6/24, three 6/60). (3 references) Ronald Lowe.

Hervouet, F. **Pathologic anatomy of**

keratoconus. Arch. d'opht. 18:431-442, June, 1958.

Hervouet disagrees sharply with certain authors who have stated that keratoconus has no specific histopathologic pattern. In a detailed study of the disease, illustrated by six adequate plates in black and white, the author concludes that certain diagnosis can be made invariably from any section passing across the ectatic portion of the cornea. He describes the following characteristic changes: 1. irregular thinning of the epithelium, with degenerative changes in the basal layer; 2. undulations of Bowman's membrane, with dehiscences at their summits; 3. thinning of the parenchyma, with variable degenerative changes; and 4. invaginations of Descemet's membrane, with degenerative changes in the endothelium. Hervouet considers the lesions of Bowman's and Descemet's membranes to be specific for the disease. (37 figures) P. Thygeson.

Lorentzen, S. E. Herpes corneae posterior. Acta Ophth. 37:80-83, 1959.

A dendritic endothelial infiltrate on the posterior surface of the cornea in a 15-year-old boy with recurrent herpes labialis is described. The dendritic figure changed into a compact endothelial infiltrate the day after the first observation which was made three days after probable onset. The eye recovered under atropine and aureomycin therapy. (3 references)

John J. Stern.

Miovski, Dimitar. Modification of Thomas' fixation suture in partial penetrating keratoplasties. Ophthalmologica 137:121-122, Feb., 1959.

Thomas' fixation suture consists of one pair of horizontal and one pair of vertical silk sutures anchored in the episclera in a direction parallel to the limbus at 3- and 9- and at 6- and 12-o'clock, respec-

tively. The vertical pair of threads is brought out through the conjunctiva at 12-o'clock and knotted there. The horizontal pair is brought out through the conjunctiva at 9-o'clock and the knot is placed there. The author of this paper splits the Thomas suture into four threads, the knots of which he places in the middle of the four quadrants. The position of the threads on the cornea remains unchanged (cfr. Arruga, Ocular Surgery). (2 figures, 1 reference)

Peter C. Kronfeld.

Nécsey, P. The changes of the epithelium of the trachomatous conjunctiva. Szemeszet 96:26-33, 1959.

The ratio of basket cells and normal epithelial cells was determined in the lavage fluid of 110 trachomatous conjunctivas and compared with the ratios obtained from acute and follicular conjunctivitis and healthy conjunctivas. In trachoma higher values were found. Apparently, the examination may be useful in differential diagnosis and investigation; the method, however, needs further study. Comparative examinations of the fragility of the conjunctiva were also made. Trachomatous conjunctivas proved to be more fragile than the others used in the comparative examinations.

Gyula Lugossy.

Neumann, E. and Blumenkrantz, N. Mucopolysaccharide in the secretion of vernal conjunctivitis. Its use as a diagnostic test. Brit. J. Ophth. 43:46-49, Jan., 1959.

The stringy nature of the secretion in vernal conjunctivitis is well known and a mucopolysaccharide is also present on the surface of the mucous membrane. It is possible that the sugar could be the cause of the stringy secretion and the toluidine blue microtest for the presence of this sugar is described. All of the

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smears from eyes with vernal conjunctivitis were positive whereas all those from normal conjunctivas were negative. It is probable that the mucopolysaccharide present is hyaluronic acid. Widespread use of this simple test for vernal conjunctivitis is recommended. (1 table, 9 references)

Morris Kaplan.

Smati. Antitrachomatous campaign in rural schools of Sétif during 1956-1957.
Rev. intern. du trachome 35:387-393, 1958.

Gantrisin 15 percent was instilled twice daily and terramycin 1 percent was given with expression of the granules and massage of the eyelids. The lesions healed in 56 percent of the subjects and 11 percent were improved. (2 tables)

José A. Ferreira.

Sztrilich, L. Serologic examinations in trachoma. Klin. Monatsbl. f. Augenh. 134:269-271, 1959.

The heterophil agglutination test was positive in 108 out of 129 trachoma patients. Only 27 out of 119 control patients had a positive reaction. (1 table, 6 references)

Frederick C. Blodi.

Topalis, C. and Georgariou, B. The diagnostic value of the Kayser-Fleischer ring. Arch. d'opht. 18:444-446, June, 1958.

The authors review the literature on the Kayser-Fleischer ring and report four cases of hepatolenticular degeneration, each showing a typical ring. Three of the subjects had hepatic cirrhosis and extensive neurologic signs including limitation of voluntary movements, phonation, articulation, and mastication, with progressive rigidity and intention tremors. They also showed mental signs, including character modifications and memory loss. The neurologic examination of the fourth patient was negative

even though she presented a well-marked ring. Topalis and Georgariou conclude that the extent and intensity of the ring is independent of the severity and duration of the general disease.

P. Thygeson.

Uzelatz, V. S. Beneficial effect of an extract of gastrointestinal mucosa on wound healing. Ophthalmologica 137: 103-107, Feb., 1959.

The healing period of traumatic corneal wounds and of lamellar keratoplasties in dogs was shortened by intramuscular administration of an extract of gastrointestinal mucosa (cfr. Am. J. Ophth. 44: 541, 1957). (5 figures, 8 references)

Peter C. Kronfeld.

8

UVEA, SYMPATHETIC DISEASE, AQUEOUS

Appelmans, M., Michiels, J. and Jamotou, L. Heterochromia and neurovascular anomalies of the iris and retina. Bull. Soc. belge d'opht. 119:519-525, 1958.

A 28-year-old woman had a peculiar association of vascular anomalies of the anterior and posterior segments, especially of the retina and also pronounced heterochromia of the iris without any other signs of Fuchs' syndrome. These disturbances of pigmentation are ascribed to anomalies in the sympathetic innervation; the eye also had a miosis, an incomplete ptosis and mild enophthalmos. The ocular tension was normal. Tonography revealed values lower than normal; the RAP was normal. Additional findings were high hypermetropia and amblyopia with a visual acuity of only 1/50. The vascular, the sympathetic, and the refractive anomalies were present since birth. They were ascribed to a forme fruste of angiomatosis, the "angiomatosis trigemini." In spite of the fact that this is a

minor anomaly and in itself not serious, it disposes to glaucoma even in the absence of mesodermal tissue in the chamber angle. (18 references)

Alice R. Deutsch.

François, J., Rabeay M. and Lagasse, A. **Examination of a uveal sarcoma under the electronic microscope.** Bull. Soc. belge d'opht. 119:504-513, 1958.

Some remarkable observations were made on this, the first malignant melanoma studied under the electron-microscope. Many cells showed constituents of normal cell structure: mitochondria, ribonucleoprotein granules, cytoplasmic vesicles, Golgi apparatus and the membranes of the ergostoplasm. On the other hand, dark-stained masses in the cytoplasm, compact granulated nuclei, spongy nucleoli and granules of Pallade were suggestive of malignancy. Virus-like granules, similar to those found in transmissible tumors were not seen. This however, does not mean that those formations are always absent and that a viral etiology of malignant melanoma can be excluded with certainty. (7 figures, 2 tables, 16 references)

Alice R. Deutsch.

Kahán, A., Lövi, M. and Rávnay, M. **The effect of tuberculin on the permeability of the human eye.** Klin. Monatsbl. f. Augenh. 134:187-191, 1959.

An intracutaneous injection of tuberculin leads to a marked increase of the permeability of the blood-aqueous barrier in eyes with tuberculous uveitis. The permeability was measured by the concentration of fluorescein in the anterior chamber after intravenous injection. This increase in permeability after a tuberculin injection is a diagnostic test for tuberculous uveitis. It was positive in 22 patients who were then successfully

treated with anti-tuberculous drugs. This phenomenon can be used in the treatment of tuberculous uveitis when the penetration of an antituberculous drug into the eye could be accelerated by a preceding subcutaneous injection of tuberculin. (7 references)

Frederick C. Blodi.

9

GLAUCOMA AND OCULAR TENSION

Boeck, J. and Stepanik, J. **Tonographic studies of the ocular effects of Depressin. (Part II).** Ophthalmologica 137:74-81, Feb., 1959.

A previous study (Modern Problems of Ophthalmology 1:115, 1957) concerned itself with the effects of single doses of intravenously administered Depressin (a hydrate of hexamethylen 1,6-bis-trimethylammonium chloride) upon normal eyes of human controls. A parallel study was made on patients with chronic glaucomas (without possibility of angle closure). Through observation of the diurnal variations of the ocular tension the time of its greatest stability was determined. Such periods were chosen for the determination of the effects of Depressin upon intraocular fluid dynamics. A tonogram was made one hour before and 10 minutes after the intravenous administration of the drug. At the latter time most of the drop in blood pressure and ocular tension had occurred and a new steady state had been reached. The results suggest that Depressin lowers the ocular tension by depression of the rate of aqueous formation. (1 figure, 3 tables, 19 references)

Peter C. Kronfeld.

Ceroni, T., Panebianco, G. and Scassellati Sforzolini, G. **A study of the vestibular function in patients with chronic simple glaucoma.** Riv. oto-neuro-oftal. 33:172-194, March-April, 1958.

Audiometric studies on 40 patients

with chronic simple glaucoma revealed a perceptive type of hypoacusia in 32 of the patients. Six patients had a presbyacusia and two had no cochlear dysfunction. Studies of the posterior labyrinth in those patients who had chronic simple glaucoma and cochlear disturbance revealed an asymmetry of vestibular function. A similar asymmetry was found in the two patients who had glaucoma without any cochlear damage. Control of the intraocular pressure altered the labyrinth response in 25 percent of the cases. The study seems to suggest an association between chronic simple glaucoma and cochlear-labyrinth dysfunction. (7 figures, 4 tables, 18 references)

William C. Caccamise.

Cross, A. G. **Malignant glaucoma.** Brit. J. Ophth. 43:57-60, Jan., 1959.

Chandler has advocated removal of the lens as the most successful treatment for malignant glaucoma. Cross describes a man, 49 years of age, who developed chronic glaucoma of the closed-angle type and had a peripheral iridectomy in one eye. He developed typical malignant glaucoma and it was thought that a swollen lens was blocking the iridectomy. Rather than extract the lens the author did a second iridectomy below, with excellent results for a few days, but he soon had to do a cyclodialysis. After a month iridotomies became necessary in the second eye and later cyclodialysis was entirely adequate. (4 references)

Morris Kaplan.

Eurico Ferreira, Luiz. **Glaucoma unit of an ophthalmology service.** Arq. bras. de oftal. 21:282-288, 1958.

Since glaucoma is such a serious disease and represents a threat to vision, specialized attention should be given to patients with the disease, and to those who are suspected of having it until the diagnosis is confirmed. With this in mind,

a glaucoma clinic will serve those who are ambulatory, while a glaucoma unit within the hospital eye service is advisable.

This routine will permit concentration of glaucomatous patients in the various phases and allow investigators to study the disease more thoroughly than otherwise. Such examinations as gonioscopy, tonography, perimetry and campimetry may be done routinely, and attention paid to the study of social and economic factors. Effectiveness of surgical treatment is better evaluated when one has a large volume of cases to work with.

The author briefly mentions the routine followed in those patients with glaucoma with a good prognosis, a bad prognosis, and those who have been subjected to surgery. It is felt that both the patient and the ophthalmologist benefit from this specialization.

James W. Brennan.

Törnquist, R. **Peripheral chamber depth in shallow anterior chamber.** Brit. J. Ophth. 43:169-176, March, 1959.

A shallow anterior chamber unquestionably predisposes to primary acute glaucoma, yet many eyes with a chamber depth of equal dimensions to those of glaucomatous eyes never become glaucomatous. The angle depth normally varies in different parts of the chamber, which may explain why the synechiae in closed-angle glaucoma occur in the upper region. The author studied this relative depth of the angle in the various parts of the chamber on patients with and without glaucoma but with normal ocular tension. The profile of the anterior chamber was photographed and the measurements were made on the photographs. The cornea was found to be spherical only in its central area and flattened out toward the periphery. The angle was found to be more narrow above than elsewhere and much more so

in the glaucomatous eyes. This difference, however, disappeared with peripheral iridectomy. (2 figures, 5 tables, 19 references) Morris Kaplan.

Valu, L. and Csüllög, F. **Gonioscopic examinations after Kettész's cyclanaemization.** Szemeszet 96:6-9, 1959.

The systematic gonioscopy of eyes after the surgery has shown that extensive pergamentization is a wrong practice, bringing about harm. No doubt, the operation leads to occlusion of the artery and the neural conduction ceases, but the extensive cicatrization may cause unnecessary damage in the surrounding tissues. Schlemm's canal will undergo obstruction at the place of cauterization, the trabecular system becomes destroyed, the absorbing surface of the iris decreases, and the capacity of the draining system is decreased. It has been shown that mild pergamentization involving only a small area may also lead to the obliteration of the artery and to the cessation of neural conduction, whereby the success of the operation may be secured without damaging the environment and without contracting the draining canals.

Gyula Lugossy.

10

CRYSTALLINE LENS

Claes and Le Grand. **Enzymatic lysis of the zonule. A preliminary report.** Bull. Soc. belge d'opht. 119:491-498, 1958.

The authors report their first 16 cataract extractions following exactly Barraquer's technique. The anterior chamber was irrigated with 1/5000 α -chymotrypsin for the first time after the keratome incision, for the second time after the iridectomy. The subluxation of the lens was evident after two minutes. Lavage of the anterior chamber with 1-percent pilocarpine solution and an air injection concluded the operation. There were no complications.

The authors apparently use this technique in young children as well, though only old patients are reported here. (9 references) Alice R. Deutsch.

Epstein, E. **Modified Ridley lenses.** Brit. J. Ophth. 43:29-33, Jan., 1959.

After implantation of a Ridley lens of larger diameter, decreased central thickness, and more tapering edges the author noted an appreciable diminution of post-operative adhesions. The lens has been used in six patients who were observed for 12 to 20 months; the visual acuity was 6/6 or better in four, 6/9 in one, and 6/12 in one.

In a second modification, the shape of the lens was that of a collar button. This lens is used after intracapsular extraction and is put in place with the iris riding in the groove; the lens rests in both the posterior and anterior chambers. Two peripheral iridotomies are made for aqueous flow. The pupil is kept miotic for several months. Of 10 patients nine are still doing well after two and one-half years; one lens was removed. The lens gives satisfactory refractive results. (4 figures, 1 table, 2 references) Morris Kaplan.

Galdino Alves, Moacyr. **Surgery of senile cataract.** Arq. bras. de oftal. 21:256-274, 1958.

This article presents the author's experience in the treatment of senile cataract since 1952, and is based upon 431 operations upon 305 patients. He prefers the Barraquer technique of a "pre-anesthetic cocktail" before local anesthesia. Fixation is made at two points below, at six-o'clock and also at eight-o'clock in the right eye and four-o'clock in the left. McLean sutures are used, and the lens is delivered by tumbling and forceps extraction. By far the majority of patients recovered 20/40 vision or better, with little or no cylinder required in the correcting lens. Complications were few; rupture of

the capsule occurred most frequently (in 11 percent). (11 figures, 1 table, 5 references) James W. Brennan.

Qvist, C. F. and Zachau-Christiansen, B. **Radiation cataract following fractionated radium therapy in childhood.** *Acta Radiol.* 51:207-216, March, 1959.

Radiation cataract occurred in four of 57 children, mostly in infants, who were given radium for cutaneous hemangioma of the head during the period of 1913 to 1933. (5 tables, 28 references)

F. H. Haessler.

11

RETINA AND VITREOUS

Blodi, F. C. and Sullivan, P. B. **Involvement of the eyes in periarteritis nodosa.** *Tr. Am. Acad. Ophth.* 63:161-165, March-April, 1959.

In a 64-year-old woman with hypertension for over three years, the diagnosis was suggested by the eye examination. The retinal arterioles were diffusely attenuated, there was a large globular, grayish detachment in the left eye, and later both eyes developed discrete retinal hemorrhages. The diagnosis was confirmed histologically. Marked hypertensive retinopathy with macular edema, papilledema, eosinophilic deposits in the retina, and retinal detachment were seen. A few areas of active nongranulomatous uveitis without lesions of the choroidal vessels were noted; periarteritis was found only around the episcleral and orbital vessels. The detachment is ascribed to the hypertensive retinopathy. (6 figures, 2 references) Harry Horwitz.

Imre, Gy. **Coats' disease.** *Szemeszet* 96: 10-19, 1959.

Four cases observed by the author and the pertinent literature favor the view that Coats' disease is a disease of the ret-

ina, and that it has an independent morbid pattern. The disease is based on vascular alterations. The latter may be congenital or secondary to metabolic disorders resulting from endocrine imbalance. This view is favored by the fact that most patients are young, near puberty. Both eyes may be affected. Often capillary aneurysms resembling those of the retina are also found in the skin and the mucosa. There is no reliable therapy. Roentgen irradiations with tumor doses are sometimes useful, therefore they should be tried. Diathermy coagulation is suggested only in partial cases. Rarely, spontaneous restitution may occur.

Gyula Lugossy.

Linnen, Hans Josef. **Experimental trials of an instrument designed for treatment of macular holes.** *Ophthalmologica* 137:113-121, Feb., 1959.

Custodis' principle of treating retinal detachments is to indent the diathermized sclera and choroid in the region of the retinal break. This indentation is produced by a plastic roll and suitably placed scleral sutures. The state of indentation is maintained until retinochoroidal adhesions are formed. Such indentations are difficult to produce at the posterior pole. The author has designed an instrument for this purpose and tried it on rabbits. The instrument consists of a plastic pad mounted on the ends of two steel wires which, in turn, are attached to a base plate that fits the anterior sclera. The plate is fastened to the sclera by means of sutures and the steel wires are bent so as to fit the sclera in meridional direction. The plastic pad is thus placed in contact with the posterior pole. The amount of pressure exerted by the pad is regulated by fastening the steel wires to the sclera with additional sutures. The instrument has been tried on rabbits and on a few irreparably diseased human eyes.

prior to enucleation. Ophthalmoscopically measurable indentations of the posterior pole have been produced. (5 figures, 1 table, 3 references)

Peter C. Kronfeld.

Lorentzen, S. E. **Large branch from the superior temporal vein crossing the macular region.** Acta Ophth. 37:84-87, 1959.

A case of this rare developmental anomaly in an eight-year-old girl with normal vision is described. (2 figures, 7 references)

John J. Stern.

Straub, W. **The importance of the electroretinogram in the diagnosis of congenital tapeto-retinal degenerations.** Klin. Monatsbl. f. Augenh. 134:178-187, 1959.

In blind children the beginning optic atrophy may be the expression of a disease of the optic nerve or it may be the first sign of a tapeto-retinal degeneration when the rest of the fundus still looks normal. The electroretinogram may here establish the diagnosis. It is normal in diseases of the optic nerve, but extinguished in tapeto-retinal degeneration. Three infants are described who had no light perception, no pupillary reactions, beginning optic atrophy, no fundus pigmentation and extinguished electroretinograms. (8 figures, 30 references)

Frederick C. Blodi.

Teng-Khoen-Hing. **Fundus changes due to vitamin A deficiency.** Ophthalmologica 137:81-85, Feb., 1959.

This is the first report from Indonesia concerning fundus changes associated with vitamin A deficiency (cfr. Pillat, Zeitschr. f. Augenheilk. 80:189, 1933). The lesions are peripheral, multiple, and look like "sugared caraway seeds." Unfortunately, the author did not have the opportunity of observing a clear-cut re-

sponse of these lesions to systemic vitamin A administration. (2 figures)

Peter C. Kronfeld.

Vedel-Jensen, Niels. **Retinal grooves caused by pressure on the globe.** Acta Ophth. 37:59-64, 1959.

Two cases are described in detail in which pressure on the eyeball (retrobulbar tumor and pansinusitis with orbital edema) resulted in the appearance of fine, parallel striations in the retina. It is assumed that the striations are located in the inner layers and purely mechanically. The changes are accentuated by retinal edema. (5 figures, 6 references)

John J. Stern.

Wallner, E. and Radnót, M. **Two cases of central vein thrombosis treated with Dicumerol.** Klin. Monatsbl. f. Augenh. 134:265-269, 1959.

These two women were treated early (first and fourth day) and the visual end result was 5/8 and 5/10. (8 references)

Frederick C. Blodi.

Weekers, R., Bonnet de Rudder, M. and Bassleer, J. **Recurrent toxoplasmic chorioretinitis.** Bull. Soc. belge d'opht. 119:514-518, 1958.

Recurrent, congenital toxoplasmic chorioretinitis has been described by Sjögren in 1950 and by Hogan in 1957 and separated from the quiet inactive congenital and the active adult variety. Clinically these cases show the combination of old scarred lesions and fresh inflammatory patches in the presence of a positive dye test titer in high solution. An individual affected with congenital toxoplasmosis might have rupture of parasitic cysts in nerve, muscle, or other tissue and in this way be exposed to the dissemination of the parasite. As the mode of transmission in acquired toxoplasmosis is not clear, the differential diagnosis between ac-

quired toxoplasmosis and recurrent congenital toxoplasmosis is very difficult. (1 table, 3 references) Alice R. Deutsch.

12

OPTIC NERVE AND CHIASM

Ambrosio, A. **Optic neuritis of probable viral etiology.** Riv. oto-neuro-oftal. 33:212-222, March-April, 1958.

The author offers a brief review of the pertinent literature and describes three cases of optic neuritis with a probable viral etiology. (6 figures, 21 references)

William C. Caccamise.

13

NEURO-OPTHALMOLOGY

Battistini, A. **Note on pupillography in a case of accommodative paralysis.** Arch. di ottal. 62:503-512, Nov.-Dec., 1958.

Pupillography after the method of Lowenstein can show minute but clinically important details of the pupillary light reflex. The relations of this reflex to the nuclei of Perlia and of Edinger-Westphal are discussed. (7 figures, 11 references)

Paul W. Miles.

Gibbs, D. C. **Chiasmal arachnoiditis.** Brit. J. Ophth. 43:52-56, Jan., 1959.

Chiasmal arachnoiditis is rare; it results in compression of the optic nerves by connective tissue septa at the chiasm. Symptoms are headache, loss of vision, and oculomotor paresis. The visual fields show irregular changes leading to bitemporal hemianopic defects. A 38-year-old man is described with the typical picture of remissions and improvement seven times in the course of eight months. The bitemporal hemianopsia was permanent. (10 figures, 1 reference)

Morris Kaplan.

Rhonheimer, Charlotte. **Symptoms of aneurysms in the sella turcica.** Klin. Monatsbl. f. Augenh. 134:1-34, 1959.

Eight patients with intrasellar aneurysm are described in detail. Most of them had headaches, and visual symptoms were prominent and early. An asymmetric chiasma syndrome is characteristic. Angiography does not always give a positive result. The onset of the symptoms is often sudden and extraocular palsies are frequent. X-ray changes of the sella are not marked, but occurred in all cases (usually only a slight erosion or atrophy, sometimes with calcification). The fifth nerve may be irritated or paretic. (22 figures, 2 tables, 21 references)

Frederick C. Blodi.

14

EYEBALL, ORBIT, SINUSES

Brain, Sir Russell. **Pathogenesis and treatment of endocrine exophthalmos.** Lancet 1:109-115, Jan. 17, 1959.

When the author coined the term exophthalmic ophthalmoplegia 20 years ago he had seen 31 cases; he has now seen over 200 and on the basis of this experience provides an extensive summary of important data and concepts. He discusses the experimental production of exophthalmos, the evidence concerning the part played by thyrotropin in man, the relation between human thyrotropin and exophthalmos, the relation between exophthalmic ophthalmoplegia and thyrotoxicosis, the orbital changes responsible for exophthalmos, and the relation to sex and age. He comments on some unusual endocrine disturbances associated with exophthalmos—persistent lactation, lipodystrophy, and generalized edema, and also discusses prognosis and therapy. He points out that prognosis is important in itself but also in relation to therapy. He discusses hormone treatment, thyroideectomy, X-ray irradiation, and orbital decompression. (36 references)

Irwin E. Gaynor.

Burnard, E. D. **Proptosis as the first**

sign of orbital sepsis in the newborn. Brit. J. Ophth. 43:9-12, Jan., 1959.

In three newborn infants proptosis of one eye was noted in two, and of both eyes in the other; there were no signs or symptoms of other illness. One infant died of generalized infection which post mortem examination showed to be a sequel of bilateral retrobulbar abscess. In one infant surgical exploration of the orbit revealed an abscess which then healed rapidly and in the third the lesion healed after chemotherapy. *Staphylococcus aureus* was the causative agent. (1 figure, 3 references) Morris Kaplan.

Diamond, Monroe Thomas. The syndrome of exophthalmos, hypertrophic osteoarthropathy and localized myxedema: a review of the literature and report of a case. Ann. Int. Med. 50:206-213, Jan., 1959.

A case is reported of a syndrome characterized by exophthalmos, hypertrophic osteoarthropathy and localized myxedema. It is suggested that careful search in cases of exophthalmos, including radiologic survey of the bones, might well show that this syndrome is not so rare as is indicated by the literature. The use of 1-triiodothyronine locally was an effective means in this case of reducing the swelling of pretibial myxedema, and deserves further trial. (2 figures, 13 references)

Author's summary.

Hameed, S., Das, T. and Agarwal, K. C. Chloroma of the orbit. Brit. J. Ophth. 43:107-112, Feb., 1959.

Two cases of chloroma of the orbit in children are described. Chloroma is a rare type of leukemia which is usually acute. The lesion is usually a localized greenish mass, and is most common in the bones of the skull. The symptoms are the same as in acute leukemia. The disease is always fatal within a few months. (6 figures, 13 references) Irwin E. Gaynor.

Murphy, Arthur L. Traumatic diplopia. Am. J. Surg. 97:518-521, April, 1959.

A depressed fracture of the zygoma not rarely produces diplopia by displacing the eye. In every case of facial injury, this complication must be looked for early, when correction is relatively simple. If diplopia is present after the facial fractures have united, bone graft on the orbital floor is recommended rather than re-fracture and restoration of the fragments. The grafting operation is simple but requires meticulous technique. (6 figures, 3 references)

Author's summary.

Nørgaard, B. and Pindborg, J. J. Acute neonatal maxillitis. Acta Ophth. 37:52-58, 1959.

A staphylococcus infection of the maxilla in a 13-day-old girl was accompanied by exophthalmos and abscesses in the orbits. Incision and the administration of antibiotics led to rapid recovery but two tooth germs were expelled. (4 figures, 11 references)

John J. Stern.

Pfeiffer, Raymond L. Infratemporal subdural hematoma as a cause of exophthalmos. A.M.A. Arch. Ophth. 61:274-281, Feb., 1959.

Four cases of unilateral exophthalmos resulting from chronic subdural hematomas are reported. The patients all had exophthalmos and X-ray evidence of enlargement of the middle cranial fossa. The exophthalmos is felt to result from the encroachment upon and indentation of the lateral orbital wall by the enlarged middle cranial fossa. This enlargement will occur only in young people whose bones are still in the maleable state. Enlargement of the superior orbital fissure and elevation of the sphenoid ridge can be seen in X-ray views of the orbit on the abnormal side. The author feels that any X-ray evidence of enlargement of the middle cranial fossa is virtually indicative of subtemporal subdural hematoma, and that this should be

suspected in cases of unilateral exophthalmos. (6 figures, 15 references)

William S. Hagler.

Vanni, V. **Ocular rigidity in various cases of exophthalmos.** *Boll. d'ocul.* 37: 636-640, Aug., 1958.

The author studied the coefficient of ocular rigidity in cases of thyrotoxicosis and found the coefficient to be normal in cases of simple thyrotoxicosis. The coefficient was reduced in cases of thyrotoxic exophthalmos and in those cases of exophthalmos associated with an ophthalmoplegic component. Unilateral exophthalmos, due to an orbital tumor, also gave low coefficient readings. The coefficient of rigidity appeared not to be influenced by the degree of exophthalmos. (2 tables, 5 references)

Joseph E. Alfano.

Vergez, A. **The temporal approach to the orbit.** *Arch. d'opht.* 18:294-343, April-May, 1958.

This is the concluding part of an article begun in No. 2 of this volume. This portion is concerned principally with indications for the temporal approach to the orbit, which include, in his opinion, most of the situations encountered in orbital surgery. Among the indications listed are 1. tumors limited to the orbital cavity, 2. mixed intracranial and intraorbital tumors, 3. intraorbital osteoma, and 4. tumors of the lacrimal gland. Tumors limited to the anterior third of the orbit can be handled generally by an anterior approach. In malignant exophthalmos the author prefers temporal decompression to the Naffziger intracranial approach. He then gives case histories illustrating the major orbital lesions best reached by a temporal approach and concludes by summarizing its advantages. He deplores purely neurosurgical intervention, outlines the major role of the ophthalmologist in orbital conditions, and stresses the

value of neurosurgical-ophthalmological teamwork. (2 figures, 1 table, 278 references)

P. Thygeson.

15

EYELIDS, LACRIMAL APPARATUS

Arruga, H. and Dou, M. **Selenium sulphide in the treatment of seborrheic blepharitis.** *Arch. Soc. oftal. hispano-am.* 18:1003-1006, Oct., 1958.

The etiology of blepharitis and the literature on selenium sulphide in dermatology is reviewed and its application in the treatment of blepharitis discussed in detail. The authors' material consisted of 108 cases, and they obtained good results in 90 percent. They use a combination of bisulfate of selenium, prednisone, and tyrotricin in a fat free ointment. (16 references)

Ray K. Daily.

Balik, Josef. **The excretion of sodium in the tears.** *Ophthalmologica* 137:95-102, Feb., 1959.

Samples of human tears were obtained by means of filter paper slips dipped into fluid contents of the conjunctival sac. The amounts of tears obtained (the rate of lacrimal flow) varied from 3 to 82 mg. The sodium concentration in these samples was slightly dependent upon the sodium concentration in the serum which varied in the author's series from 236 to 512 mg. percent. The sodium concentration in the tear samples decreased exponentially with the rate of lacrimal flow. (1 figure, 2 tables, 4 references)

Peter C. Kronfeld.

Bill, Inga. **A case of stenosis in the lacrimal sac caused by vaccinia.** *Acta Ophth.* 37:33-34, 1959.

Vaccinia infection of the lower lid following smallpox vaccination gave rise to dacryostenosis. Probing was ineffectual and a dacryocystorhinostomy had to be performed. The possibility that the tear

sac infection could have been caused by syringing during the acute phase of the condition is discussed. (15 references)

John J. Stern.

Broggi, R. J. **The treatment of congenital dacryostenosis.** A.M.A. Arch. Ophth. 61:30-36, Jan., 1959.

Increased pooling of tears plus a history of epiphoria is sufficient for a diagnosis of congenital dacryostenosis. It is best treated by early probing, using the syringe-cannula technique. Spontaneous cures leave a patent stenotic nasolacrimal duct. Bilateral probing is advocated. (1 figure, 39 references) Irwin E. Gaynon.

Chang, John Chiao-Nan. **Entropion in Hong Kong.** Brit. J. Ophth. 43:88-96, Feb., 1959.

Trachoma is the major cause of blindness in the far east. Trachomatous entropion is predominant in the female and has its greatest incidence in subjects in the fifth and sixth decade of life. Early in the disease the sharp posterior border of the lid margin disappears. The skin-muscle approach to the tarsus is advocated. (3 figures, 1 table, 12 references)

Irwin E. Gaynon.

Combes, F. C. **Epithelioma of the lower eyelid successfully treated with Grenz rays.** Australian J. Dermat. 4:89, 1957.

Grenz rays are useful in the treatment of superficial epitheliomas of the eyelids. They are unsuitable for treatment of more infiltrating tumors. One case is presented.

Ronald Lowe.

Darabos, Gy. **Two cases of epiblepharon and congenital entropium.** Szemeszett 96:46-48, 1959.

Two cases of epiblepharon associated with congenital entropium are reported. One of the patients was a 14-year-old boy on whom Hotz's operation was performed. The other was an infant, nine

months of age, in whom the entropium of the one side healed spontaneously. On the other eye general anesthesia resulted in the cessation of muscular spasm whereby the lid edges returned to normal position and the operation was postponed.

Gyula Lugossy.

Desvignes, P. and Amar, L. **Angiomata of the lids.** Arch. d'opht. 18:414-430, June, 1958.

The authors present a comprehensive review of the subject with extensive bibliography. They consider the tumor to be invariably congenital and they discuss in detail pathogenesis, pathologic anatomy, clinical features, evolution, and treatment. They consider injections of sclerosing agents to have first place in treatment and note that accidents are rare and embolic phenomena unknown. Cryotherapy they regard as having the advantage of being a benign and painless office procedure but they note the inconvenience of repeated applications. Electrolysis they consider to be useful only in minimal stellar or punctiform angiomas. The various forms of radiation therapy and the various surgical techniques with all their indications and contraindications are considered in detail. They note that surgery tends to be scar-producing and that skin grafting is often necessary. They conclude with a discussion of indications for therapy of angiomas, particularly in the newborn. (73 references)

P. Thygeson.

Ebadi, A. J. **Entropion operation with the "hidden suture."** Rev. intern. du trachome 35:394-400, 1958.

A modification of Snellen's procedure is described in which the final stitch is hidden and gives less scarring. (11 figures)

José A. Ferreira.

Galvez Montes, Jose. **A family with Waardenburg's syndrome.** Arch. Soc.

oftal. hispano-am. 18:1053-1056, Oct., 1958.

A genealogic tree of five generations is reported, various members of which had lateral displacement of the internal canthi, congenital ptosis, heterochromia of the iris and premature grayness. (3 figures, 2 references) Ray K. Daily.

Gharib, R., Burke, E. C. and Brunsting, L. A. *Juvenile xanthogranuloma with ocular involvement*. J. Pediat. 54:109-112, Jan., 1959.

Juvenile xanthogranuloma is suggested as the best diagnostic term for the condition characterized by yellowish-brown nodules of the skin present at birth or shortly thereafter. The blood lipids are normal and the general health is unaffected. Spontaneous involution of the lesion occurs. The histologic picture consists of proliferation of histiocytes and xanthomatous giant cells.

One case of nevoxantho-endothelioma with involvement of the eye is reported. Inasmuch as the lesions are benign and tend to regress, the ocular globe should be left intact with the hope of eventual return of vision. (3 figures, 13 references)

Authors' summary.

Jones, L. T., Reese, A. B., Veirs, E. R. and Cassady, J. V. *Symposium: the lacrimal apparatus*. Tr. Am. Acad. Ophth. 62:669-690, Sept.-Oct., 1958.

Jones, L. T. *Practical fundamentals of anatomy and physiology*. pp. 669-678.

The anatomy of the lacrimal region is reviewed in detail. The author's dissections show that the medial canthal ligament does not extend into the tarsi, but rather gives origin to the superficial heads of the pretarsal muscle in its anterior portion. The origins of the upper and lower superficial heads of the pretarsal muscle, the upper and lower heads of the superficial preseptal muscle, the upper and lower heads of the deep preseptal

muscle, and the superficial and deep heads of the corrugator are clearly illustrated.

Jones describes his concept of a lacrimal pump which works by creating negative pressure in the tear sac. He cautions that ointments should not be used in the drainage system, the punctum and ampulla must be preserved, the tear sac should be removed only for a malignant neoplasm, the "pumping" muscles should not be sacrificed, and success can be adjudged only by a positive dye test. (11 figures, 8 references)

Reese, A. B. *The treatment of lesions of the lacrimal gland*. pp. 679-683.

Reese studied 112 expanding lesions of the lacrimal gland, 31 percent were due to granuloma, of which 26 were nonspecific dacryoadenitis, five were sarcoid, and four were Hodgkin's disease; 24 percent were due to carcinoma, 22 percent to mixed tumor which has a benign cytology but a malignant behaviour, 21 percent to lymphosarcoma and two percent to adenoma, which were probably ectopic lacrimal glands.

A new approach in the surgery is described. A brow incision is made and a deep wedge of tissue is removed for biopsy. If "mixed tumor" is found a modified Krönlein operation is done; if carcinoma the skin is closed, and the next day the patient is told that exenteration of the orbit is required. If it is lymphosarcoma the closure is made and radiotherapy is advised. If it is chronic granuloma then the incision is simply closed.

The brow incision is prolonged postero-laterally to give adequate exposure for a Krönlein resection, using the Stryker saw to free the bone. This produces little blemish. Deformity in exenterating the orbit is held to a minimum by transplanting the temporalis muscle into the orbit. (1 figure, 1 table, 8 references)

Veirs, E. R. *Abnormalities and treatment of the punctum and canaliculus*. pp. 684-686.

For occlusion of the punctum, the membrane should be punctured. Many other disorders of the canaliculus can be corrected by the three-snip operation, which is described. In absence of the canaliculus a new one can be made; a free split-thickness skin graft is wrapped around some polyethylene tubing. In stenosis one may produce new channels by using flaps of conjunctiva. In infantile stenosis pressure irrigation is preferable to probing. In ectropion an enlarged caruncle may have to be excised. The "three-snip" operation is indicated in mild cases, and the Kuhnt-Szymonowski procedure is required in severe cases. Cicatricial ectropion may require free skin grafting.

Much epiphora can be prevented by gentleness in manipulations, avoidance of irradiation and scar formation, meticulous repair of an injured lower canaliculus, and avoidance of irritants such as sunlight, Furmethide, silver nitrate and chronic infections.

Cassady, J. V. **Abnormalities and treatment of conditions of the lacrimal sac and duct.** pp. 687-690.

Various congenital anomalies of the lacrimal system are discussed. Disease of many types can be found: bacterial and fungal infections, injuries, and neoplasms. Strictures may be catarrhal, fibrous or bony. The use of radio-contrast media such as Pantopaque is advised. For older children the author uses chloroform in the office. Fistulous tracts are excised and cauterized. The preferred method of dacryocystorhinostomy is that of Dupuy-Dutemps, which is described in detail.

Harry Horwich.

Levitt, J. M. and Kravitz, D. **Lacrimal air anomalies.** A.M.A. Arch. Ophth. 61:9-13, Jan., 1959.

The valve of Hasner is thought to be a barrier to the entrance of air and fluids from the nasal chamber. With incompetency, usually congenital, air may be

blown into the tear sac, forming a pneumatocele. Tearing may result from an atonic tear sac. Treatment consists of gently blowing one nostril at a time and at the same time, pressing firmly on the area of the tear sac. (5 figures, 3 references)

Irwin E. Gaynor.

Moore, L. H. G. **Perspex prosthesis for the lacrimal sac and naso-lacrimal duct.** Brit. J. Ophth. 43:186-188, March, 1959.

As an alternative to dacryocystorhinostomy, a permanent nasolacrimal prosthesis has been designed. It is made of transpex I and is inserted over a large Bowman probe by force through an open incision over the canaliculus and sac. It is left in place permanently and in seven cases it has been satisfactory for as much as two years. In the event of failure the procedure does not interfere with subsequent surgery. (1 figure)

Morris Kaplan.

Pajtas, J. **Recurrent lid edema in children.** Ophthalmologica 137:34-44, Jan., 1959.

Fifteen cases of recurrent lid edema due to intestinal parasites are reported. (3 figures, 4 references)

Peter C. Kronfeld.

Pico, Guillermo. **Dacryocystorhinostomy.** Tr. Am. Acad. Ophth. 62:709-711, Sept.-Oct., 1958.

A modification of the Dupuy-Dutemps procedure, wherein a circling silk suture is retained in the lacrimal passages, is described. The suture is removed on the seventh postoperative day. (8 references)

Harry Horwich.

Smith, Byron. **Eyelid surgery.** Surg. Cl. North America 39:367-378, April, 1959.

The author reviews a few of the common methods used in the repair of full-thickness defects of the lids. His text is

made perspicuous by excellent figures which combine the virtues of skillfully made realistic drawings and pedagogic diagrams. (7 figures, 4 references)

F. H. Haessler.

Stallard, H. B. **Treatment of malignant neoplasms of the eyelids. Surgery or irradiation?** Brit. J. Ophth. 43:159-168, March, 1959.

During the last 25 years there has been an increasing tendency to treat malignant lesions of the eyelids by irradiation despite the fact that surgical removal is the therapy of choice in many instances. The removal for biopsy for proper evaluation of irradiation should be supplanted by total removal. The complications of irradiation are often extensive necrosis and scarring of the skin, occlusion of various parts of the lacrimal apparatus, superficial punctate keratitis, cataract and iridocyclitis with secondary glaucoma. Total excision with proper reconstructive grafts to close the defects can be relatively easy, the results considerably more acceptable, and the incidence of recurrence of the neoplasm appreciably less. (15 figures, 8 references)

Morris Kaplan.

Sweebe, E. C. and Cogan, D. G. **Adenocarcinoma of the Meibomian gland.** A.M.A. Arch. Ophth. 61:282-290, Feb., 1959.

Eight cases of Meibomian gland adenocarcinoma are presented; six of them were initially diagnosed and treated as a chalazion. Two patients had metastases to the regional lymph nodes proven by histological examination. Both of these patients subsequently died but autopsies were not performed. It is strongly urged that any "chalazion" that fails to respond to customary therapy or which recurs after spontaneous rupture should be examined histologically. If these tumors are incompletely removed they tend to change from slow growing lesions to fast growing

tumors with active malignancy and rapid metastases. (32 references, 12 figures)

William S. Hagler.

Turi, K. **Dynamics of simple congenital ptosis before and after Blaskovics' operation.** Szemeszet 96:34-42, 1959.

The observations of the author on 52 Blaskovics' ptosis operations are discussed. In 20 patients the dynamics of motion of ptotic lids was examined before and after the operation. The author claims, and documents with photographs, that reduced function of the levator muscle is manifest in cases of congenital ptosis, not only on upward but also on downward rotation of the bulbus. Therefore the fact that the upper lid does not keep pace with the downward rotating bulbus after Blaskovics' operation, a phenomenon giving rise to many objections though causing little trouble to the patient, is a sequel of the congenital hypo-function of the levator and has little to do with the operation. In cases in which the functional capacity of the levator was good before the operation (ptosis due to injury) its downward motion will be satisfactory after the operation also.

Gyula Lugossy.

Váry, I. **Excision of fascia in Blaskovics' operation for ptosis.** Szemeszet 96: 43-45, 1959.

The author suggests a more extensive resection of the fascia in cases of excessive ptosis because the operation becomes more effective.

Gyula Lugossy.

Villalobos, Y. **Epitheliomas of lids.** Arch. chil. de oftal. 15:41-45, Jan.-June, 1958.

The author describes the clinical and histologic findings in two patients with epithelioma of the lids. One of them was cured with surgical excision followed by radiotherapy; the other did not return after initial biopsy. (4 figures, 2 references)

Walter Mayer.

16 TUMORS

Darabos, G. **A basal cell epithelioma produced by the temple piece of a spectacle frame.** Klin. Monatsbl. f. Augenh. 134:100-101, 1959.

The spectacle frame was metal and constantly irritated the skin of this 66-year-old man. The weight of the cataract lenses may have contributed. (1 figure)

Frederick C. Blodi.

Dunphy, E. B., Forrest, A. W., Leopold, I. H., Reese, A. B. and Zimmerman, L. E. **Symposium: the diagnosis and management of intraocular melanomas.** Tr. Am. Acad. Ophth. 62:517-555, July-Aug., 1958.

This symposium was presented as a series of questions put to the members of the panel.

An external sign of melanoma is an increase in number or caliber of blood vessels in the episclera. A mass or nodule may be seen on the sclera and increased resistance to palpation may be felt with a blunt instrument. A pigmented mass may appear in the pupil. Sector anesthesia of the cornea, partial paralysis of the iris, dilatation of iris blood vessels, pigment dust on the iris and cornea may be seen. The lesion may be seen in the chamber angle or on the iris, through the iris, or at an iridodialysis site.

The ophthalmoscope can be used to demonstrate a melanoma by lateral transillumination in scattered light when the light is focused on a different part of the retina. One can also see abnormal vascular patterns over tumors; light brown pigmentation is characteristic whereas ordinary reparative and proliferated pigment is black. Transillumination, both transscleral and transpupillary, is recommended.

The use of radioactive phosphorus for diagnosis in properly selected anterior lesions is reliable in 95 percent of cases. The

reliability is considerably less with posterior lesions. The dosage used in testing is considered to be safe since it is below that which will produce depression of bone marrow function and lymphoid tissue function. However, pregnant women should not have this test as embryonic tissue is much more sensitive to radiation than normal adult tissue.

Biopsy is not recommended; it can cause considerable damage to the eye through hemorrhage, loss of vitreous, or retinal detachment and is dangerous because of dissemination of malignant tissue. With the slitlamp and gonioscopy one can make photographs or drawings which are important in the diagnosis of growth. In malignant melanoma of the iris the surface is elevated; the malignant lesion looks fleshy with prominent vascularization, and as pigment increases there is a thickening of the iris, loss of normal markings, and filling in of the crypts. Benign lesions have regular borders and are not elevated. The value of routine gonioscopy in these cases cannot be stressed too highly.

In differential diagnosis of lesions of the iris and ciliary body, one must consider intraepithelial cyst, staphyloma, anterior synechiae, metastatic tumor, dictyoma, lymphosarcoma, and melanosis. Detailed observations are described to clarify a differential diagnosis.

The prognosis is poorer in larger tumors, which are usually spindle cell, than in small tumors, usually epithelioid cell in type. Only three of the 23 patients whose eye was enucleated lived to a normal life expectancy; 19 died of metastasis and one of intercurrent disease. Pregnancy may accelerate the growth of a pre-existing melanoma, but therapeutic abortion will not benefit a mother with uveal melanoma. Any extraocular extension, whether it be gross or microscopic, has a very poor prognosis; in such cases, exenteration of the orbit is recommended.

Diathermy probably has no place in the therapy of uveal melanoma, radiation, even from radon seeds sutured to the sclera, and chemotherapy are not recommended. It is too early to evaluate the heliocautery of Meyer-Schwickerath. (17 figures, 5 tables, 57 references)

Harry Horwich.

Fanta, H. **Melanoma of the chamber angle metastasizing along an aqueous vein.** *Klin. Monatsbl. f. Augenh.* 134:66-71, 1959.

A 38-year-old woman had an iris tumor which had grown during the preceding two years; it obscured the chamber angle in that segment and the intraocular pressure was elevated. The vision was normal. Two aqueous veins were markedly pigmented. Histologic examination of the enucleated globe revealed a malignant melanoma of the iris and the ciliary body which extended along Schlemm's canal into the deep scleral veins and the two aqueous veins. (5 figures, 1 reference)

Frederick C. Blodi.

François, J., Rabaey, M. and Lagasse, A. **Examination of one uveal sarcoma with the electron microscope.** *Ophthalmologica* 137:65-73, Feb., 1959.

The ultrastructure of one malignant melanoma of the choroid (spindle cells, type B) was studied with the electron microscope. The tumor cells showed a number of morphologic characteristics of normal cells but also "certain particularities of other tumor cells." (7 figures, 2 tables, 16 references)

Peter C. Kronfeld.

James, D. Geraint. **Ocular sarcoidosis.** *Am. J. Med.* 26:331-339, March, 1959.

Ocular lesions were observed in 50 of 200 patients with sarcoidosis. They included subacute or chronic iridocyclitis, conjunctivitis, keratoconjunctivitis sicca and conjunctival follicles. The differences

between subacute and chronic iridocyclitis are striking. This is in part due to corticosteroid therapy, which has probably changed the natural history of sarcoid iridocyclitis.

Involvement of other tissues is correlated with ocular disease and the pattern is compared with that observed in patients without eye involvement. Ocular sarcoidosis is commonly accompanied by intrathoracic and cutaneous lesions and by lymphadenopathy. Reduced secretions due to simultaneous lacrimal and salivary gland involvement may superficially resemble Sjögren's syndrome.

Compared with those without eye lesions, patients with ocular sarcoidosis belonged to an older age group, females predominated and Mantoux tests were more often negative.

The clinical diagnosis should be confirmed, whenever possible, by histologic evidence of sarcoid tissue. This was obtained by biopsy of various tissues and also by means of the Kveim test, which was positive in the majority of patients with ocular disease. Blind conjunctival biopsy was of no diagnostic help.

The natural course of sarcoidosis is towards spontaneous healing by fibrosis. In the eye this may cause serious complications, so ocular involvement is an absolute indication for early and energetic corticosteroid therapy. (1 figure, 13 tables, 22 references)

Author's summary.

Straatsma, Bradley R. **Eosinophilic granuloma of bone.** *Tr. Am. Acad. Ophth.* 62:771-776, Nov.-Dec., 1958.

A two-year-old boy with a unilateral painless exophthalmos of several months duration is described. A bony-hard mass was palpable laterally and skull films showed an irregular moth-eaten erosion. Biopsy revealed necrosis and granulation tissue and occasional eosinophiles and large pale histiocytes. Systemic administration of prednisolone and tetracycline

caused a regression, but a relapse occurred and this time the child developed diabetes insipidus and skin lesions to complete the Schüller-Christian triad. Microscopic study of the grayish-red tissue confirmed the diagnosis. (7 figures, 4 references)

Harry Horwitz.

Vanneste, L. and Bernolet, J. **Rhabdomyosarcoma of the orbit.** Bull. Soc. belge d'opht. 119:498-504, 1958.

The histopathology, pathogenesis, prognosis and treatment of rhabdomyosarcoma of the orbit are discussed with special emphasis on the investigations of P. Masson and on statistical reviews of Stout. The tumor observed by the authors occurred in a 21-year-old man. His personal informations were not reliable. He had had diplopia for a while, and the vision of his left eye had been impaired for about three weeks. The objective findings were those of a retrobulbar tumor. After the completion of the clinical diagnosis a fairly well encapsulated tumor as large as an average egg was excised. It was densely adherent to Tenon's capsule. The pathological diagnosis was rhabdomyosarcoma. (1 figure, 9 references)

Alice R. Deutsch.

17

INJURIES

Gimenez Almenara, Julian. **A foreign body at the vertex of the orbit extracted by an original technique.** Arch. Soc. oftal. hispano-am. 18:1026-1042, Oct., 1958.

A piece of an ivory canula was lodged in the vertex of the orbit in a 10-year-old child. In spite of the administration of antibiotics it produced a suppurative process and had to be extracted. Because of inaccurate X-ray localization an attempt was made to extract it through the maxillary sinus; this failed. So did an attempt to reach it through an inferior orbitotomy. It was finally extracted by following its

route of penetration, and using a large Killian nasal speculum to reach the vertex of the orbit; focal illumination facilitated the operation. Recovery was uncomplicated. The author advocates the use of this speculum for exploration of the orbit. (7 figures, 24 references)

Ray K. Daily.

Lorente Buesa, M. **Two unusual cases of intraocular foreign body.** Arch. Soc. oftal. hispano-am. 18:1017-1021, Oct., 1958.

One of these patients who had a fine puncture wound of the skin near the left lateral orbital margin was dismissed as one insignificantly injured by the first-aid ophthalmologist. Visual disturbance led the patient to seek further help and an X-ray examination revealed an extraocular foreign body, which was extracted with a magnet. The second patient had bilateral intraocular foreign bodies. In the right eye an iron sliver had penetrated the sclera 8 mm. from the limbus, but was visible under the conjunctiva. In the left eye it had penetrated the cornea and was in the anterior chamber. The sliver in the right eye was 9 mm. in length, and repeated attempts with the magnet were required to make enough of it protrude so that it could be grasped with forceps. The foreign body in the anterior chamber was 4 mm. in length and was extracted with the magnet through the original corneal wound. (4 figures)

Ray K. Daily.

Mathur, S. P. **Allergy to antivenine serum.** Brit. J. Ophth. 43:50-51, Jan., 1959.

A 35-year-old woman was bitten by a nonpoisonous snake but received antivenine serum as a routine precaution. Six days later she complained of blurred vision and was found to have mild edema of the lenses and of the papillae which were ascribed to an allergic reaction to the antivenine serum. The condition

gradually cleared over a period of three months without treatment. (4 references)

Morris Kaplan.

Nørgård, Bent. **The oxycephalic cranium. Report of a case with traumatic causation.** *Acta Ophth.* 37:49-51, 1959.

In a 74-year-old man severe cranial trauma at the age of 18 months was followed by oxycephaly. Inhibition of growth of the damaged coronal suture is assumed. The cranial fracture had been left-sided, and exophthalmos and divergent strabismus were present on the right side; the fracture might have acted like a decompression operation. (2 figures, 1 reference) John J. Stern.

Oksala, Arvo. **An intraocular wooden foreign body diagnosed by ultrasound.** *Klin. Monatsbl. f. Augenh.* 134:88-93, 1959.

This method is of value when the posterior segment cannot be explored ophthalmoscopically. In a 38-year-old man the eye had to be enucleated because of an intraocular fragment of wood and the localization by echo was found to be correct. (4 figures, 6 references)

Frederick C. Blodi.

Ribas Valero, Ramon. **X-ray localization of intraocular foreign bodies.** *Arch. Soc. oftal. hispano-am.* 18:1022-1025, Oct., 1958.

Two X-ray procedures are advocated because of their simplicity and because they do not require preliminary surgery. One consists in applying a metallic ring over the lids which have been closed with a piece of gauze, the ring is also covered with gauze and the eye is then bandaged. In the antero-posterior film the foreign body lies within the ring. In the lateral projection with the patient looking up and down the position of the foreign body is estimated from its displacement with ocular movements. The second procedure

consists in applying the ring directly over the anesthetized cornea, and then immobilizing it by a bandage over the closed lids. (6 figures)

Ray K. Daily.

Shapiro, H. H., Huffman, W. C. and Lierle, D. M., Dunn, C. A., Smith, B., and Kahn, E. A. **Fractures of the facial skeleton: a panel discussion.** *Tr. Am. Acad. Ophth.* 62:649-668, Sept.-Oct., 1958.

Smith, Byron, **Orbital complications of facial fractures.** pp. 665-666.

One may have deformity from lateral displacement of the medial canthus. Fracture of the lacrimal duct occurs, causing stenosis. The inferior oblique may be torn from its origin, although incarceration of the inferior oblique and inferior rectus in fractures of the floor are more common. If this is not treated properly, secondary contracture will occur. The superior oblique tendon may be torn off, brain tissue can rupture through a fracture in the roof, and carotid-cavernous fistula can occur. Lacerations and hemorrhages of the globe are common.

Harry Horwich.

18

SYSTEMIC DISEASE AND PARASITES

Garron, L. K. **Cystinosis.** *Tr. Am. Acad. Ophth.* 63:99-108, Jan.-Feb., 1959.

After a brief review of the clinical and laboratory findings in cystinosis, a seven-year-old girl with cystinosis is described in detail. The child had been treated for five years for diabetes insipidus; she was dwarfed, had renal rickets, craved salt, never perspired and did not lacrimate until four years of age. The corneas looked glazed, and at the slitlamp a mass of fine, polychromatic sparkling crystals were seen in the corneal stroma and in the bulbar conjunctiva. There was no clear area near the limbus. The child died in uremic pneumonitis and cystine deposits were found in the bone marrow,

spleen, liver, lymph nodes, adrenals and kidneys. Tissues must be fixed in absolute alcohol rather than formalin to preserve the crystals. Cystine deposits were found in the cornea, conjunctiva, ciliary body, choroid, sclera, episclera and the extraocular muscles. (9 figures, 6 references)

Harry Horwich.

Giaquinto, M., Appelmans, Boithias, R., d'Haussey, R., Lagraulet, J., Vellieux, M., Le Breton-Oliveau, G. and Straub, W. **Symposium on intraocular parasitosis:** Bull. et mém. Soc. franç. d'opht. 71:239-307, 1958.

Part I: Onchocercosis.

Offret, in his introductory remarks, considered onchocercosis to be a very serious disease, often leading to blindness. He also called attention to many interesting questions which have arisen and pointed out that it was the purpose of this symposium to clarify some of the problems.

Giaquinto, Mira. **Intraocular parasitosis.** pp. 239-243.

Giaquinto emphasized the peculiarities of this complex disease which has affected 20 millions in continental Africa and Central America and in endemic areas in other parts of the world. Diseases of the anterior segment, caused by infection with *Oncocerca volvulus*, have been recognized for a long time; diseases of the posterior segments, however, were not necessarily ascribed to this parasite but to the accidental simultaneous appearance of an entirely different disease.

Appelmans. **The African onchocercosis, a paradoxical disease.** pp. 244-247.

In certain regions of central Africa practically all of the natives have onchocercosis. The morphology of the parasite is paradoxical. The male is 3 cm. long, the female 40 or 50. She is extremely fertile. The microfilaria are about 300 microns long, are very motile and have a special affinity for connective tissue. Fi-

laria may be found in apparently healthy tissue and allergic reactions may occur. A high blood eosinophilia is always present. Biopsies establish the diagnosis. The treatment of choice is the excision of adult parasites. Hetrazon kills the microfilaria but the necrotic parasites cause severe allergic reactions. Ocular complications depend on the presence of microfilaria in the ocular tissues, yet microfilaria have been found in the aqueous of otherwise normal eyes. Punctate superficial keratitis without epithelial defects is the most characteristic ocular affliction in Africa.

Boithias, René. **Aspects on African onchocercosis.** pp. 248-257.

This essay is a clinical and statistical review on about 4,000 of 16,000 natives with onchocercosis and 1,298 eyes were practically blind. Both the anterior and posterior segments were the site of abnormal findings. Treatment with Notezine and Moranyl was only temporarily effective. (32 references)

d'Haussey, Roger. **Pseudo-tapeto-retinal degeneration and onchocercosis.** pp. 258-265.

The earliest manifestation noted was hemeralopia. Threshold studies and adaptation curves showed defects first in the rods, followed by progressive changes in the cones. Defects in the nasal sector of the field were characteristic. The clinical picture showed progressive degeneration of the pigment epithelium. The histopathologic studies revealed vascular changes in the choriocapillaries as well as in the other vascular layers of the choroid. (13 references)

Lagraulet, J. **Ocular onchocercosis in Africa and America.** pp. 266-276.

In Mexico onchocercosis is an endemic disease, particularly in two specific regions, the zones of Oaxaca and Chiapas; 35 percent of the afflicted persons had eye lesions, especially of the cornea, iris, and optic nerve. The retinal disease has only

been observed rarely, compared with similar groups of patients in Africa; blindness caused by onchocercosis occurred in 500 of 500,000 affected, a much smaller percentage than in Africa. Excision of specific nodules and treatment with hetrazon probably account for the comparatively benign course. The histopathologic characteristics of the chorioretinal lesions, the pathogenesis and the biochemical qualities of the specific toxins are discussed with emphasis on the discrepancy between the gravity of the vascular changes and the mild inflammatory changes. (35 references)

Vellieux, M. and Le Breton-Oliveau, G. **The African ocular onchocercosis.** pp. 277-293.

Usually the diagnosis was made from smears and by biopsies of small skin pieces. Findings were positive in 44 percent of the children examined and in 67 percent of the adults. Chemotherapy as a whole has been disappointing. Complete excision of the nodules which enclose the microfilaria mostly checks the disease. The most severe eye lesion with permanent visual impairment was caused by the toxic effects of dead parasites and the severe local reactions to their necrotic debris. (4 figures, 1 table)

Part II: Toxoplasmosis.

Straub, W. **Experimental toxoplasmosis in the rabbit and guinea pig.** pp. 294-307.

Toxoplasmosis can be reproduced in the mouse, the guinea pig and the rat. In this study 36 rabbits and 31 guinea pigs were used. They were inoculated with the ascites fluid of diseased mice. Among the seven rabbits whose conjunctiva was exposed to the parasites, the reactions were from mild to severe necrotic conjunctivitis. In 11 rabbits the intraarterial, intravenous or intracardiac route was used. The animals with severe ocular involvement also had severe general disease. The

potential extracellular multiplication of the parasites could be observed in the cell-free exudate of a lens in a guinea pig eye. This lens was accidentally injured when the vitreous was inoculated with toxoplasma. Attention is called to the small specific orbital lesions during an orbital spread of the disease. (7 figures, 24 references)

Appelmans. **Bilateral macular toxoplasmic chorioretinitis in a 7-year-old child.** pp. 303-307.

The manifestations of toxoplasmosis in children are especially interesting because of the potential difficulties in the differential diagnosis between congenital and acquired forms. A 7-year-old girl had a rubella-like rash and pneumonia and, a year later, a mild lymphocytic meningitis. Eight months later a bilateral macular chorioretinitis was seen together with a mild anterior uveitis. The dye test for toxoplasma was positive in a titer of 1/128 which at this age is very suggestive for the diagnosis of an active stage. The high fever, the rash and the pulmonary complications could be ascribed to an invasion of the toxoplasma organism at this special period and so mark the time when the disease was acquired. Nevertheless it could have been the recurrence of a congenital disease.

Alice R. Deutsch.

Mateos, Jose L. **Ocular changes in acanthosis nigricans.** Arch. Soc. oftal. hispano-am. 18:1043-1052, Oct., 1958.

The literature on this rare complication is reviewed and a case reported in which, in addition to the typical cutaneous lesions, there were numerous papillomatous excrescences on the palpebral margins. The patient died of a gastric carcinoma. The importance of acanthosis nigricans in the diagnosis of visceral carcinoma and its metastasis is emphasized. (7 figures, 15 references)

Ray K. Daily.

Neu, Hans Joachim. **Favorable course of bilateral blindness in temporal arteritis.** *Klin. Monatsbl. f. Augenh.* 134:250-259, 1959.

A 57-year-old woman experienced sudden blindness in both eyes. Both fundi were anemic and showed a few hemorrhages. The ESR was 45 mm./hour. A biopsy of the temporal artery did not show any inflammatory changes. Vision was recovered after a week of treatment with Prednisone. (3 figures, 32 references)

Frederick C. Blodi.

19

CONGENITAL DEFORMITIES, HEREDITY

Ruedemann, A. D. **The electroretinogram in hereditary visual cell degeneration.** *Tr. Am. Acad. Ophth.* 63:141-160, March-April, 1959.

Over 60 subjects were studied in this series. The method for electroretinography is given in detail. With fields reduced to 5 degrees of fixation, the electrical potential of the retina was extinct; in ring scotoma the electric potential was reduced and abnormal; a- and b- waves were reduced in variable relation, and the eyes were affected symmetrically with no variation of the findings attributed to cause or heredity.

Detailed family studies and individual cases are presented, well illustrated by E.R.G. tracings, visual fields, and visual acuities. A discussion on this condition in several different animal species is added. (9 figures, 3 diagrams, 5 tables, 14 references)

Harry Horwitz.

Trivella, G. and Valvo, G. **Concerning an unusual association of congenital malformations.** *Riv. oto-neuro-oftal.* 33:223-234, March-April, 1958.

The authors discuss in detail the case of a six-year-old boy with the unusual combination of congenital malformation of the eye (congenital retinal fold) and of

the larynx (diaphragm and doubling of one vocal cord). A review of the literature failed to reveal any previous similar case report. (3 figures, 28 references)

William C. Caccamise.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Duke-Elder, Stewart. **Franciscus Cornelis Donders.** *Brit. J. Ophth.* 43:65-68, Feb., 1959.

A short résumé of the biography of Franciscus Cornelis Donders, a great biologist, physiologist, and ophthalmologist, is given.

Irwin E. Gaynor.

Magitot, A. **Les Annales d'oculistique et de gynecologie.** *Ann. d'ocul.* 192:1-8, Jan., 1959.

Magitot reviews the history of the Annales d'oculistique and states that it is the oldest journal in ophthalmology. Its original title was Annales d'oculistique et de gynecologie and Volume I appeared in 1838; only in the following year was the present name adopted. A front plate of the original journal is included in the article. It is of interest that the presence of this first volume was discovered by Curt Stern and Gordon Walls of the University of California. Magitot points out that the story of this discovery appeared in the American Journal of Human Genetics for December, 1957.

David Shoch.

Trevor-Roper, P. D. **The royal oculist.** *Brit. J. Ophth.* 43:1-2, Jan., 1959.

This essay is a brief memorial and biography offered on the fiftieth anniversary of the death of Carl Theodore, Duke of Bavaria and renowned oculist. He was born in 1839 and practiced ophthalmology. He performed 5,600 eye operations and was assisted in these by his wife. One of his daughters is the present Queen Elizabeth of the Belgians. (2 figures)

Morris Kaplan.

NEWS ITEMS

EDITED BY DONALD J. LYLE, M.D.
411 Oak Street, Cincinnati 19, Ohio

News items should reach the editor by the 10th of the month. For adequate publicity, notice of postgraduate courses and meetings should be received three months in advance.

DEATHS

Dr. Carl Conrad Beisbarth, St. Louis, Missouri, died March 13, 1959, aged 57 years.

Dr. Kenneth Charles Brandenburg, Long Beach, California, died March 10, 1959, aged 59 years.

Dr. Jules Mark Nova, Freeport, New York, died December 12, 1958, aged 79 years.

Dr. Armenius C. Hobbs, Columbus, Georgia, was struck by an automobile and killed on May 8. Dr. Hobbs was born in Cataula, Georgia, on January 27, 1920. He attended Emory University, received his medical degree from the Medical College of Georgia, and did his postgraduate work at the Thigpen-Carter Eye Hospital, Birmingham, Alabama. Dr. Hobbs served as a captain in the Army Medical Corps, and was a consultant on ophthalmology at Fort Benning and at Tuskegee (Alabama) Veterans Administration Hospital. He was a member of the French Ophthalmological Society, a diplomate of the American Board of Ophthalmology, a fellow of the American Academy of Ophthalmology and Otolaryngology and a member of the Association for Research in Ophthalmology, Inc.

ANNOUNCEMENTS

LIGHT COAGULATION COURSE

Prof. Dr. G. Meyer-Schwickerath announces a second course in light coagulation to be given December 1 through 5, 1959. The course will be conducted in English. For further information write to Dr. Meyer-Schwickerath, Augenklinik, Essen, Germany.

COLUMBIA UNIVERSITY CHAIRMAN

Dr. Arthur Gerard DeVoe has been appointed chairman of the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, New York, to succeed the retiring chairman, Dr. John H. Dunnington.

Dr. DeVoe was born in Seattle, Washington, in 1909, and was graduated from The Phillips Exeter Academy in 1927. He received an A.B. degree from Yale University in 1931, the M.D. degree from Cornell University in 1935, and the degree of D. Med Sci., from Columbia in 1940. His internship was served at Bellevue Hospital, New York, and his residency at the Institute of Ophthalmology, Presbyterian Hospital, New York. He became a diplomate of the American Board of Ophthalmology in 1940, and served as major in the Medical Corps, United States Army, 1942 to 1946. From 1940 to 1950 he was assistant attending ophthal-

mologist, Presbyterian Hospital and Vanderbilt Clinic. In 1950 he became associate of ophthalmology, College of Physicians and Surgeons, Columbia University. From 1950 to 1959 he served as professor and chairman of the Department of Ophthalmology, New York University Post-Graduate Medical School, and director of eye services, Bellevue Hospital and University Hospital. He was consultant in ophthalmology, Veterans Administration Hospital, Bronx, 1946-1954; Manhattan Veterans Administration Hospital, 1954; and is now consultant at the New York Eye and Ear Infirmary, St. Clare's Hospital, and St. Vincent's Hospital.

Dr. DeVoe is a member of the American Medical Association, American Academy of Ophthalmology and Otolaryngology, American Ophthalmological Society, Association for Research in Ophthalmology, New York Academy of Sciences, New York Ophthalmological Society, Société Francaise d'Ophthalmologie, Pan-American Ophthalmological Society, American College of Surgeons (Fellow 1946). He was a member of Board of Governors, American College of Surgeons, representing the American Medical Association, Section on Ophthalmology, and the American Ophthalmological Society 1955-1958. He serves on the Board of Directors, the Ophthalmological Foundation and on the Research Committee, National Council to Combat Blindness, Ophthalmology Training Grant Committee, National Institute of Neurological Diseases and Blindness. He was a member of the American Board of Ophthalmology, 1958.

Dr. DeVoe served as an associate editor of the *Archives of Ophthalmology* from 1952 to 1955, and as chairman of the Section on Ophthalmology, New York Academy of Medicine, 1957-1958. He has published 17 papers on ophthalmic subjects.

COURSE IN CORNEAL SURGERY

A concentrated course in corneal surgery will be given for two and one-half days under the direction of Dr. A. Benedict Rizzuti at the Brooklyn Eye & Ear Hospital on Thursday, Friday and Saturday, November 19th, 20th and 21st.

Present surgical concepts of kerectomies and keratoplasties will be stressed. Allied subjects, such as beta radiation, contact lenses, operating room photography, instrumentation, and so forth, will be discussed by staff members. Surgical procedures in the operating room will be demonstrated according to availability of donor material. Participants will be offered an opportunity to apply surgical principles on animal eyes.

The course is limited to eight ophthalmologists;

tuition is \$100.00 Address inquiries to Mr. Henry Williams, Superintendent Brooklyn Eye and Ear Hospital, 29 Greene Avenue, Brooklyn 38, New York.

SOCIETIES

NEW YORK OFFICERS

Officers of the New York Society for Clinical Ophthalmology for the coming 1959-1960 season are: President, Dr. Joseph Laval; vice president, Dr. Alfred Kestenbaum; recording secretary, Dr. Alan H. Barnert; corresponding secretary, Dr. Leon H. Ehrlich; treasurer, Dr. Henry M. Kera; historian, Dr. Robert S. Coles. Committee chairman are: Program, Dr. Abraham Schlossman; instruction session, Dr. Alfred Weintraub; legislative, Dr. Benjamin Rosenthal; membership, Dr. Howard Agatston; industrial, Dr. Edward M. Douglas. Dr. Arthur Linksz, the retiring president, was elected to the advisory council.

OREGON CONVENTION

At the 18th annual ophthalmology and otolaryngology postgraduate convention sponsored by the Oregon Academy of Ophthalmology and Otolaryngology and the University of Oregon Medical School in Portland, June 26th to 30th, ophthalmic guest speakers were: Dr. Walter S. Atkinson, Watertown, New York, "Anesthesia in ophthalmology," "Anesthesia in ocular surgery," and "Procedures which decrease complications of cataract extraction." Dr. Robert N. Shaffer, San Francisco: "Gonioscopy," "Pupillary block in malignant glaucoma," "Some facets of glaucoma therapy." Dr. Arthur C. Jones, Boise, Idaho, presented a paper on "External approach to dacryocystorhinostomy."

KANSAS CITY OFFICERS

Elected as officers of the Kansas City Society of Ophthalmology and Otolaryngology for the 1959-1960 sessions were: President, Dr. Byron J. Ashley; president-elect, Dr. G. O. Proud; vice president, Dr. Larry Calkins; secretary, Dr. J. T. Robison; treasurer, Dr. R. B. Wilson; custodian, Dr. R. E. Bridwell.

COLORADO MEETING

The Colorado Ophthalmological Society and the University of Colorado School of Medicine co-sponsored a postgraduate course in ophthalmology at Aspen, Colorado, July 6th through 9th. The theme of the meeting was "New developments and future trends in ophthalmology." Guest speakers were Dr. Alson E. Braley, Iowa City, Iowa; Dr. Rocko M. Fasanella, New Haven, Connecticut; Dr. William H. Havener, Columbus, Ohio; and Dr. Phillips Thygeson, San Jose, California. University of Colorado faculty members participating were Dr. Bernard E. Campbell, Dr. John A. Egan, and Dr. William M. Lewallen. Officers of the Colorado society are: President, Dr. Gertrude S. Hausmann; vice president, Dr. William K. Kuhlman; secretary, Dr. Max Kaplan; treasurer, Dr. George A. Filmer. Dr. George A. Filmer, Dr. John C. Long, Dr. Morris Kaplan and Dr. J. Leonard Swigert were members of the program committee.

SECTION MEETING

The annual scientific session of the Section on Ophthalmology, American Medical Association, was held in Atlantic City, New Jersey, from June 10th to 12th. The attendance was excellent. Dr. S. P. Meadows of London, England, and Dr. Paul C. Bucy of Chicago, Illinois, were guests of honor. The following prizes and honors were awarded:

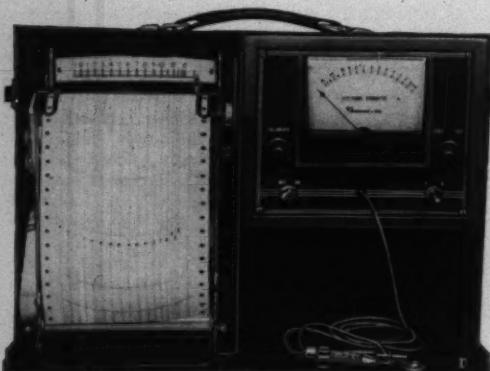
1. The Prize Medal in Ophthalmology was awarded to Francis Heed Adler for his many contributions to our specialty.

2. The \$250 prize for the best exhibit was awarded to Gilbert Baum and Ivan Greenwood for their exhibit, "Application of ultrasonic locating techniques to ophthalmology."

3. The \$250 prize was awarded to Thomas P. Kearns, Robert M. Salassa, Collin S. MacCarty, and James W. Kernohan for their paper, "Ocular manifestations of pituitary tumor in Cushing's syndrome," judged on the basis of presentation and originality. The following officers were elected: Harold G. Scheie, chairman; Paul A. Chandler, vice-chairman; Henry F. Allen, secretary; Frank W. Newell, representative to Scientific Exhibit.

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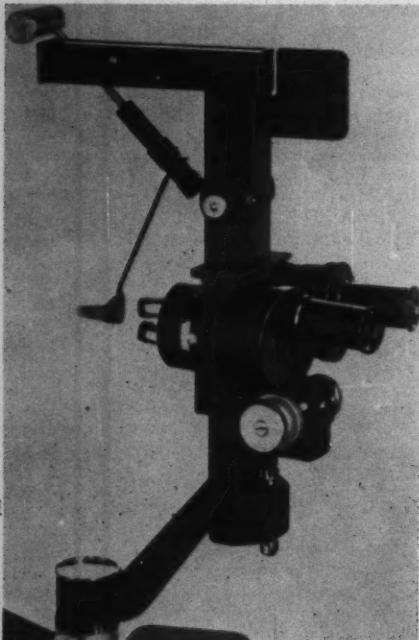
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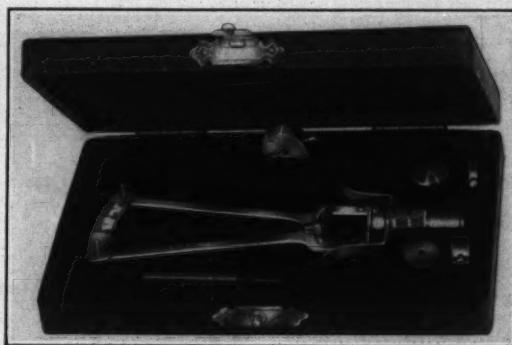
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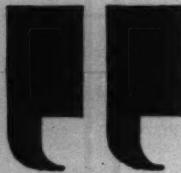
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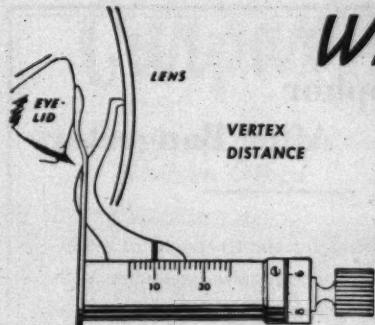
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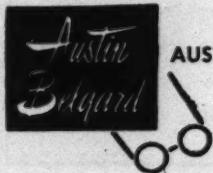
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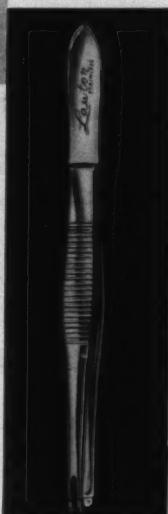


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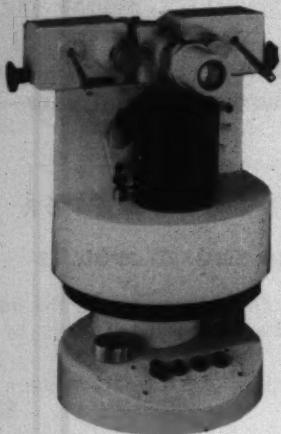
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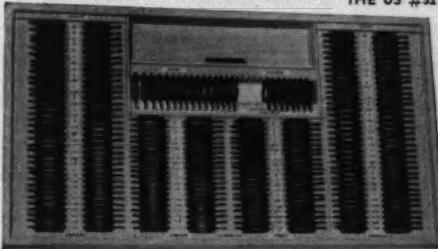
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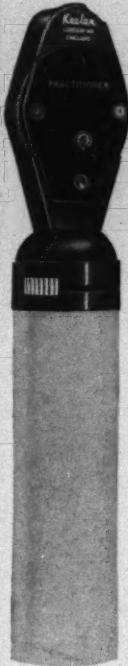
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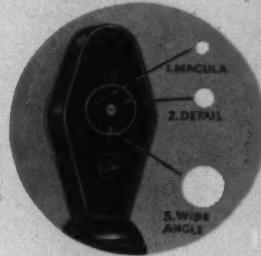
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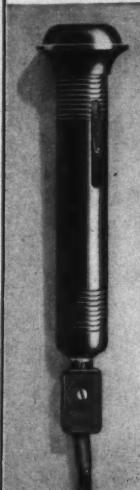
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